The Impacts of Restricting Mobility of Skilled Service Workers: Evidence from Physicians*

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Abstract

We study the question: why do skilled services firms use non-compete agreements (NCAs), which prohibit workers from leaving firms and competing against them? We conduct a survey of physicians linking the use of NCAs to labor market outcomes and firm performance, and show that by deterring the poaching of patients NCAs increase the rate of return to job-tenure, with larger effects in states with more enforceable NCA laws. These effects are consistent with NCAs enabling practices to allocate clients to new physicians through intra-firm patient referrals, reducing a form of investment holdup. We discuss an array of suggestive evidence supporting this as the primary explanation, although we find NCAs also provide benefits by reducing job turnover.

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1 Introduction

Firms that provide skilled services face unusual difficulty controlling their assets, the most valuable of which are often the relationships that exist between their workers and clients. While this problem is not unique, it is more severe for high-skilled service firms, where information asymmetries between clients and workers make search costly and generate loyalty. Skilled workers that leave a firm often have the ability to take clients with them to another firm. In this sense, a stock of loyal clients is similar to more traditional forms of human capital, and may affect productivity and earnings. Consequently, the decision by a firm to refer clients to a worker, which has some chance of transferring loyalty to the worker, is comparable to the general human capital investment decision considered by Becker (1962). However, whereas Becker shows that workers will either explicitly or implicitly pay for such investments themselves, in many cases such as medicine there may be legal restrictions to writing a contract that even implicitly assigns a price to patient referrals.

Without the ability to price referrals, the firm may face an investment holdup problem. Consider the problem of a physician who owns a practice and employs other physicians. The firm owner has no direct control over the firm's relationship-assets, and also cannot capitalize them. Even if an intra-firm client referral has the potential to increase total profits, the firm owner may not make the referral if the ex post returns to the investment are captured by the worker, as in the problem considered by Grossman and Hart (1986).[1] While service firms may not be able to overcome this control problem directly, they can instead mitigate investment holdup problems using personnel policies to control the rights of the worker over a relationship-asset.[2]

We examine how non-compete agreements (NCAs) can alleviate inefficiencies that may arise in service firms that cannot control their relationship-assets in more conventional ways. The NCAs that we study are clauses of employment contracts that prevent workers from exiting a firm and then competing against it.[3] The motivation for using NCAs is clear in many settings, such as firms that invest in technology they do not legally own, and the control of which may be affected by knowledge flows caused by job mobility (Fallick, Fleischman, and Rebitzer, 2006; Gilson, 1999). However, NCAs are also used frequently by high-skilled service firms that do not appear to invest in intellectual property, suggesting NCAs provide a different form of benefit in this setting. Although a quickly growing literature in labor economics has studied the use and impacts of NCAs in a variety of employment

[1] Grossman and Hart (1986) present a model in which contracts that assign specific rights may be incomplete. Due to contractual incompleteness, residual rights of control assigned to one party or another inevitably create distortions. If these distortions affect the ex post allocation of returns to ex ante investments, they can lead to investment holdup problems.

[2] Rebitzer and Taylor (2007) describe one such policy common in large law firms: up-or-out promotion contests in which the winners of the contest are the residual claimants of the assets.

[3] There are two broad types of NCA contracts. NCAs in employment contracts prevent employees from competing against a firm following a job separation. Corporate NCAs prevent the owners of a firm from selling the firm and then competing against it. We focus exclusively on employment-based NCAs.

settings, there is no previous research systematically documenting or studying their use in high-skilled service firms (Fallick et al. 2006; Garmaise, 2011; Ghosh and Shankar, 2016; Gilson, 1999; Marx, Strumsky, and Fleming, 2009; Starr 2015).

The goal of our investigation is to answer the question: what motivates skilled service firms to impose NCAs? We consider several potential explanations. First, high-skilled service firms may use NCAs to prevent the poaching of clients. Second, firms could use NCAs to reduce costs associated with job turnover. Marx et al. (2009) study a natural experiment in Michigan, and find that laws permitting enforcement of NCAs reduce the job mobility of inventors by about 8%, suggesting that this channel could benefit firms more broadly. The third explanation, which is a frequent concern in the legal evaluation of NCAs (Bishara 2011,) is that firms may use NCAs to create monopsony power. For example, workers who have signed NCAs may have less bargaining power in subsequent negotiations, potentially flattening their earnings profiles. However, it is not clear that this explanation alone would benefit firms in equilibrium unless workers were myopic or uninformed.

To provide intuition about the first explanation, we develop a theoretical model that demonstrates the potential for NCAs to alleviate investment holdup problems, allowing skilled-services firms to increase their productive efficiency. A unique feature of service providers is that a provider's relationship with a client is a form of durable human capital. The impact of NCAs centers on whether this human capital associated with patient relationships is general or firm-specific. Becker (1962) defines general human capital investments as those that are "equally useful in many firms," increasing the worker's marginal product by the same extent in each firm. If patients were always willing to follow their doctor to a different practice within a geographic market, then patient relationships would be perfectly general human capital. In contrast, specific human capital investments increase productivity only in the firm making the investment, and have no use in other firms. By preventing physicians from taking patients with them to another practice in the same geographic market,[4] NCAs have the effect of converting patient relationships, which would otherwise be general human capital that increases productivity at many firms, into firm-specific capital by making the patient relationships worthless to the physician outside of the practice that imposes the NCA. Although the distinction between general or specific human capital relates in most settings to an inherent feature of the capital itself, NCAs create a unique problem by allowing firms to choose ex ante whether to make their subsequent investments in client relationships either specific or general.

There are several reasons why physician practices in particular may care about the distinction between general and specific human capital. If patient relationships were general, Becker (1962) shows that workers must pay for these investments, yet in the case of physician-patient relationships this may difficult to achieve. Legally, both explicit and im-

[4]Specifically, NCAs in physician employment contracts forbid a physician from treating *any* patients in a designated geographic are for a fixed period of time following a job separation.

plicit payments for patient referrals are often forbidden, as they violate anti-kickback laws in the US and many other countries. To the extent that advertising is an important mechanism for recruiting patients, physicians in group practices rarely advertise their services as individuals, whereas advertisements for medical provider organizations are more common. Without extracting a payment for general human capital investments made by the firm, and without individual physicians making direct investments in recruiting patients, general human capital investments may be inefficiently low due to investment holdup problems, as discussed by Grossman and Hart (1986). By converting general capital into firm-specific capital, NCAs offer firms a mechanism to overcome this investment holdup, leading firms to increase their investments in patient relationships. This problem is not unique to physician practices. Rebitzer and Taylor (2007) describe an alternative, but similar, personnel policy common in large law firms: up-or-out promotion contests in which the winners of the contest are the residual claimants of the firm. This personnel policy can also mitigate investment holdups related to client relationships, and may be an alternative personnel policy to NCAs where they are forbidden, as they are in the legal sector.

To empirically assess the potential explanations for the use of NCAs, we conducted a survey of 1,967 primary care physicians in 5 states (CA, GA, IL, PA, and TX), with samples derived from the American Medical Association's Physician Masterfile. A unique feature of our survey is that we observe which physicians have signed NCA agreements, in addition to panel data on earnings, incentive-based payments, firm financial performance, and patient vignette data that elicit diagnostic skill and knowledge of treatment best-practices. We link the survey data to a legal database constructed by Bishara (2011) that quantifies the relative strength of enforceability of NCA laws across states, which we use in the analyses as a source of intensive-margin variation in the restrictiveness of NCAs.

Our primary empirical analyses focus on testing the hypothesis that physician practices use NCAs to prevent poaching and retain control over patient relationships. The literature on the effects of on-the-job human capital investments on earnings suggests that general human capital investments increase the rate of return to experience, while firm-specific investments increase the return to tenure (Becker 1962, Acemoglu and Pischke 1999). Since NCAs cause client relationships to become firm-specific human capital, under our hypothesis any associated increase in productivity should not be portable to other jobs, suggesting that any impact of NCAs on earnings growth should be attributed to larger returns to job tenure rather than experience. Using three years of longitudinal earnings data per physician, we estimate that NCAs increase the annual rate of earnings growth by an average of 8 percentage points in each of the first 4 years of a job, with a cumulative effect of 35 percentage points after 10 years on the job. Applying an adaptation of the two-step decomposition model of Topel (1991), we show that the difference in earnings growth associated with NCAs is caused by larger returns to job tenure, and NCAs have little impact on returns to experience. We test the conditional exogeneity of job mobility, and find no

evidence that this result is driven by correlations between the use of NCAs and unobserved practice characteristics, such as managerial ability or productivity. Moreover, we show that the magnitudes of these effects are larger in states that make the enforcement of NCAs easier, providing some reassurance that the patterns are driven by NCA policies as opposed to sorting on unobserved worker or firm characteristics.

We provide a range of suggestive evidence further supporting the conclusion that these earnings effects are not driven by selection into NCA contracts on unobservables. For example, we show that physician practices that use NCAs negotiate the same prices with private insurers, suggesting little difference in unobserved quality. In addition, our survey includes patient vignettes designed by clinical experts to elicit clinical knowledge, diagnostic skill, and treatment recommendations, and we show that these measures are all uncorrelated with NCA use. We also use a database from Lavetti and Hausman (2017) quantifying longitudinal variation in NCA laws in every state linked to a complete census of all physicians in the US from 1996-2007 from the CMS MPIER file, and show that physicians do not respond to changes in state NCA laws when choosing geographic locations, suggesting that the heterogeneity in earnings effects of NCAs is unlikely to be driven by geographic sorting.

Although the earnings models are our primary analyses, we make use of the rich information in the survey to offer several forms of corroborating supportive evidence. For example, we show that employed physician practices that use NCAs are able to retain more of their high-reimbursement patients with private or Medicare insurance, and treat fewer uninsured or Medicaid patients. This contributes in part to physicians with NCAs generating 17% more revenue per hour of patient care. We also show that the structure of compensation is different in employment contracts containing NCAs, with stronger productivity-based incentives that counteract the potential decline in bargaining power associated with NCAs. We emphasize that these stylized descriptive statistics are presented only to enhance and clarify the interpretation of our main earnings results.

After finding evidence consistent with NCAs being used to reduce the risk of poaching, we evaluate whether reductions to job turnover also contribute to the benefits associated with using NCAs. Consistent with evidence from Marx et al. (2009) and Fallick et al. (2006), we find that physicians with NCAs have about 12% longer job-spells, and provide suggestive evidence that this effect does not appear to be entirely driven by selection into NCA contracts. However, combining our estimates of the impact of NCAs on job turnover with earnings effects, we conclude that if reductions in turnover were the only benefit associated with NCA use, firms would have to face hiring costs in excess of $650,000 per physician, nearly 4 years of average annual earnings, to justify the observed wage differentials. Although reductions in turnover may be one source of benefit to firms, this high implied hiring cost suggests turnover is unlikely to be the primary explanation why physician practices use NCAs.

The paper proceeds as follows: Section 2 provides background on the empirical setting

and the nature of NCA contracts. Section 3 presents a theoretical model used to motivate our empirical hypotheses. Section 4 describes the data used in the analyses. Section 5 discusses the empirical evidence and results. Section 6 concludes and discusses policy implications.

2 Empirical Setting and Legal Background

2.1 Physician Practices

Although the questions we discuss apply generally to firms that provide high-skilled services, our empirical analyses focus on primary care physicians, including family medicine, general internal medicine, and pediatrics. Primary care physicians, which comprise about 39% of practicing physicians in the US, typically serve as the first point of contact for patients and as coordinators of their care. Consequently, they tend to have lasting relationships with their patients.

Physician practices are generally organized as either solo practices with one physician, or as group practices with multiple physicians. In group practices, physicians may be either owners or employees. Group practices typically use compensation contracts that combine a fixed salary, an individual productivity component, and a firm profit component. This creates incentives for physicians who make referrals to keep patients within a practice whenever reasonable.[5] Operating a group practice generally requires substantial investments in recruiting new physicians, and in developing relationships with a stock of patients to maintain demand for the new physicians' services. Accordingly, practices have strong incentives to protect these investments from competitive threats. This is also evident from the fact then when a practice is sold, the main factor determining the transaction price is often the stock of patients.

2.2 Non-Compete Agreements

Our survey data provide the first known systematic documentation of how prevalent NCAs are among physicians—we find that about 45% of primary care physicians in group practices are bound by NCAs.[6] Section 5.1 discusses several important aspects of heterogeneity in the use of NCAs.

Whereas NCAs often restrict workers from joining another firm in the same industry, in service industries like healthcare that have geographic markets, NCAs are geographic in scope. Physician NCAs, for example, prevent a departing physician from practicing any medicine anywhere in an ex-ante defined geographic area for a specified period of time.

[5] See Shortell (1972) for a thorough discussion of physician referral behavior that is consistent with the idea that physician referrals are affected by financial interests.

[6] The American Medical Association discourages the use of NCAs in medicine. See AMA Code of Ethics, SO 9.02.

NCA restrictions without geographic limits are generally not enforceable for physicians, which allows physicians to continue to work in medicine without a career detour, but only if they move out of the local area and bear the associated costs. Although states differ in how large the defined geographic markets can be, examples of common market definitions used in NCAs involving physicians include the county containing the practice or a 20-mile radius around the practice. NCAs must also not be excessive in duration, and two to three years is often deemed reasonable. Some NCA contracts allow physicians to pay damages in lieu of leaving the market. For example, under an NCA recently upheld in Kansas, a family physician leaving a medical group was prohibited from practicing for three years in the same county as the group unless she paid the group 25% of her earnings during the period.[7]

As elements of labor contracts, NCAs are subject to review at the state level, and the ability to enforce NCAs is based on state case law and applicable statutes. Currently, NCAs are enforceable to at least some extent in every state except North Dakota. Thirty-nine states follow common law, while the remaining eleven states have passed specific legislation that guides the enforcement of NCAs.[8] In common-law states, the precedent that determines enforceability of NCAs was generally shaped long before modern healthcare and insurance markets existed.[9] The inertial nature of common law makes NCA laws slow to adapt to changing market conditions, although they do evolve somewhat over time (Bishara, 2011).

While variation in the ability to enforce NCAs across states offers an opportunity for comparative analysis, a difficulty for empiricists has been finding a way to characterize this variation. Popular summaries of the enforcement of NCAs, such as Wilson (2006), broadly divide states into three groups: those where non-competes are judged "unenforceable" (7 states), those where they are judged "enforceable" (36 states) and those where case law is judged uncertain (9 states). While this categorization has the appeal of being easy to apply, in practice issues of enforcement are much more nuanced then these summaries suggest.[10] Recently, a much more careful and precise quantification system was developed in Bishara (2011). Based on legislation and case law in each state, Bishara (2011) scores the overall ability to enforce NCAs on a state-by-state basis along each of eight different dimensions. Our empirical analyses make use of these quantified restrictiveness scores, which we refer to as 'Bishara Scores,' and Appendix Table A2 reports the questions and rules used in developing these scores.

[7] See Sorrel, AL (2008). For other anecdotal examples see Ligos (2000) or Wilson (2006).

[8] The eleven states are: AL, CA, CO, DE, FL, LA, MA, MT, ND, OK, and TX.

[9] In common law states, courts evaluate three criteria to assess the enforceability of NCAs. First, whether the firm has a legitimate business interest behind the use of the NCA, and whether that interest is capable of being protected by the NCA. In the past, courts have recognized business assets such as confidential client lists as protectable. Second, whether the NCA imposes an undue burden on the worker. Third, whether the NCA is contrary to the public interest.

[10] See Malsberger (2006) for a detailed review of the legal treatment of non-competes on a state-by-state basis.

2.3 Legal Constraints in Physician Compensation Contracts

One important stylized feature of physician labor markets is that there are many constraints on the factors that can be used to determine compensation. One constraint of particular importance is that accepting payments for patient referrals is not only viewed as unethical, but is per se illegal in the US; yet, in many other settings commissions or bonuses for client referrals are both accepted and commonplace.

Specifically, the Ethics in Patient Referral Act of 1989 (and amendments made under the Comprehensive Physician Ownership and Referral Act of 1993) requires that "any amount paid by an employer to a physician...who has a bona fide employment relationship with the employer" must be "consistent with the fair market value of the services, and...not determined in a manner that takes into account (directly or indirectly) the volume or value of any referrals by the referring physician...."(42 CFR 411.357 (c))[11] The Code of Federal Regulations (42 CFR 411.352 (g)) adds restrictions on compensation arrangements in practices that treat Medicare patients, requiring that "no physician who is a member of the group practice directly or indirectly receives compensation based on the volume or value of his or her referrals."[12] However, it is explicitly permitted to base compensation on a physician's output or on the amount of revenue they generate, or to use per capita group profit sharing (Olson and Stanley, 2004).

[11]Olson and Stanley (2004) summarize several exceptions to the Act related to physician group practices and compensation arrangements:

> "A physician in a group practice may be paid a share of overall profits of the group, or a productivity bonus, based on services performed or services incident to personally performed services as long as the share or bonus is not determined in any manner that is directly related to the volume or value of patient referrals by the physician.
>
> Another group of exceptions relates to compensation arrangements. The term "compensation arrangement" means any arrangement involving any remuneration between a physician (or an immediate family member) and an entity. "Remuneration" is broadly defined to include any remuneration paid directly or indirectly, overtly or covertly, in cash or in kind. Under this group of exceptions, the following are *not considered to be illegal compensation arrangements* [emphasis added]: ...
>
> - Any amount paid by an employer to a physician who has a bona fide employment relationship with the employer for the provision of services if the employment is for identifiable services, the amount of the remuneration under the employment is consistent with the fair market value of the services and is not determined in a manner that takes into account the volume or value of any referrals by the referring physician, and the remuneration is provided persuant to an agreement that would be commercially reasonable even if no referrals were made by the employer...."

[12]Subsequent regulations in Fed Reg 2007;72:51012-99 provide explicit safe harbor in defining fair market value if compensation is determined by "the 50th-percentile national compensation level for physicians with the same physician specialty...."

3 A Model of Service Firms with NCAs

Our goals in this section are (1) to articulate an example of a theoretical model in which physician practices value NCAs because they prevent patients from being poached, (2) to use the predictions from the model to motivate the intuition behind our empirical analyses.

The model is simplified to include only necessary features for motivating our analyses, and abstracts from potentially interesting extensions such as the structure of firms or the role of physical capital. However, the model does incorporate important legal constraints discussed above in Section 2.3 by prohibiting compensation contracts that may potentially be interpreted as including an implicit or explicit purchase or sale of patient referrals. Without these features, which may be unique to medical professionals, the model could be adapted to generate different predictions in alternative settings.

3.1 Basic Model Setup

We consider a two-period model of a firm owned by a physician proprietor, indexed by a, who is endowed with P patients, which she can treat to generate revenue

$$Y = f(P)$$

where f is assumed to satisfy: $f(0) = 0$, $f'(P) > 0$, and $f''(P) < 0$. The strictly concave production function f can be interpreted as the monetary equivalent of the utility the owner would receive by treating the patients, net of any utility lost to providing the effort and time required to treat the patients.

Alternatively, the owner could hire a worker physician, indexed by w. In this case, the owner can choose to allocate ("refer") $P_w \equiv P - P_a$ patients to the worker, and the firm's per-period profit is given by:

$$\pi = f(P_a) + f(P_w) - S$$

where S is the cost of paying the worker's salary. Since f is strictly concave, it is potentially advantageous for the owner to share the patients with the worker and pay the worker's salary. However, any allocated patients P_w become loyal to the worker physician, who may then poach the patients.

The worker may exit the firm in the second period for two reasons. First, with probability $(1-\rho)$ the employment relationship exogenously becomes unproductive and the worker and firm separate, where $0 < \rho < 1$. Second, if the worker can earn a higher salary in the outside competitive market she will voluntarily exit, taking any allocated patients with her. The outside option salary for a physician without any patients is denoted $\bar{S}$, and the outside option increases to $f(P_w)$ for a worker with P_w loyal patients.

In order to prevent the worker from poaching patients in the second period, the owner may require the worker to agree to an NCA. If a worker signs an NCA and the job is then

terminated for any reason, allocated patients are returned to the owner, and the worker must exit the geographic market. At the beginning of period 1, workers have heterogeneous geographic location preferences R_w, expressed in monetary units, which are distributed uniformly $R_w \sim U[0, \bar{R}]$, and are private knowledge of the worker. Larger R_w indicate high willingness to pay for staying in the geographic market, which increases the expected cost of signing an NCA. At the end of period 1, workers receive geographic preference shocks with a discrete uniform distribution $\varepsilon \sim \{-e, e\}$, where $e = \frac{\bar{R}}{2}$. Therefore the sum $(R_w + \varepsilon) \sim U[-e, \bar{R} + e]$ is a continuous uniform distribution. If $R_w + \varepsilon$ is sufficiently negative, relative to earnings potential, workers may increase their utility by moving to a new geographic market.

The timing of events occurs as follows. At time zero, firms post take it or leave it offers that have three elements: (1) non-compete agreements $\{N, C\}$, where N corresponds to a contract with an NCA, and C to a contract without, (2) first-period compensation, S_1, and (3) second-period compensation, S_2. Workers observe all posted offers and choose jobs that maximize earnings $S_1 + S_2$, net of any expected relocation costs $\mathbb{E}[R_w]$.[13] Firm owners then make patient referral choices. Production occurs, workers and firms earn payoffs, and then exogenous separation draws ρ are realized. Workers then announce whether they wish to voluntarily exit the job.

Contractual commitments to allocate P_w are forbidden, and as discussed in Section 2.3, compensation in each period must be based on fair market value and may not include an implicit purchase or sale of patient referrals. We impose this legal constraint by assuming a minimum salary $S \geq \bar{S}$ in each period, which is consistent with fair market value and prevents workers from forgoing salary to implicitly purchase referrals.[14]

We begin the model by considering fixed salary compensation only, and allowing one-sided forward commitments by the firm to guarantee S_2. We then consider an extension of the model in which future salary commitments have limited credibility—firms can guarantee not to cut earnings, but they may not credibly commit to guarateed salary increases. These assumptions about contract structures play an important role, because once a worker has signed an NCA their reservation salary decreases in the second period due to the cost of relocating.

Firms maximize the sum of expected profits over the two periods $\pi_1 + \pi_2$. Workers choose jobs that maximize two-period earnings net of expected relocation costs, $S_1 + S_2 - \mathbb{E}[R_w]$.

Hedonic wage theory (Rosen, 1974) says that the competitive market salary will be determined by the preferences of the marginal worker, who has a value of $R^\star$ that makes them indifferent to accepting an NCA. Since we are interested in studying a mixed equilibrium,

[13] Note that when choosing jobs, workers do not require compensation for the risk that their preferences will change in the future, leading them to voluntarily exit the job. However, firms do consider this possibility when maximizing profits.

[14] We are grateful to an anonymous referee for noting that removing this model assumption may lead to alternative model predictions.

in which some jobs include NCAs and others do not, we assume that $\bar{R}$ is sufficiently large that some workers would never accept an NCA at any price that firms are willing to pay. The hedonic equilibrium is therefore characterized by a single worker with preferences $R^\star$ that determines assignment to jobs: workers with $R_w < R^\star$ sort into jobs with NCAs, and workers with $R_w > R^\star$ sort into jobs without NCAs. For simplicity, we also assume that $R^\star > e$, which implies that workers who sort into jobs without NCAs will never choose to relocate (as long as their earnings do not decrease in period two.)

Earnings Path and Patient Referrals Without NCAs

If a contract does not include an NCA, the firm owner maximizes profits by solving:

$$\max_{P_a} 2f(P_a) + (1+\rho)f(P_w) - S_1 - \rho S_2$$

where $P_a = P - P_w$. The worker will accept the offer as long as $S_1 + S_2 \geq 2\bar{S}$.

Working backwards, in the second period the firm must offer the worker at least the outside option salary, $S_2 \geq f(P_w)$, to prevent the worker from voluntarily exiting. This second period constraint captures the idea that once a worker controls patients P_w they bring more value to an outside firm, increasing output above the level that could be produced by a worker without patients, $\bar{S}$. Knowing this, the firm would ideally like to offer the bundle $\{S_1, S_2\}$ at which the two-period participation constraint is binding, which implies $S_1 = 2\bar{S} - S_2 = 2\bar{S} - f(P_w)$. However, this contract requires the worker to implicitly pay the agent for the value of referrals, $f(P_w)$, which the worker then recoups in the second period. In practice this contract would be illegal because physicians are prohibited from receiving explicit or implicit compensation for referrals. This prohibition on both overt and covert markets for patient referrals is fundamentally why NCAs can create value in this setting, offering protection against losing valuable assets for which there is no market.

To model this legal constraint, we assume the agent must offer the fair market salary, without accounting for the value of referrals: $S_1 \geq \bar{S}$. Given this legal restriction, the initial participation constraint $S_1 + S_2 \geq 2\bar{S}$ cannot bind with equality. When both the retention constraint and legal constraint bind: $S_1 = \bar{S}$ and $S_2 = f(P_w)$. The firm's problem is then:

$$\max_{P_a} 2f(P_a) + f(P_w) - \bar{S}$$

The FOC is

$$\frac{\partial \pi}{\partial P_a} = 2f'(P_a) + f'(P_w)\frac{\partial P_w}{\partial P_a} = 0$$

$$\Rightarrow \quad f'(P_a^{C\star}) = \frac{f'(P_w^{C\star})}{2}$$

Earnings Path and Patient Referrals With NCAs

Contracts that include NCAs are more complicated, because the probability of separation may depend on earnings. The unconditional probability of separation is given by:

$$\mathbb{P}[sep] = (1-\rho) + \rho\mathbb{P}\left[R_w + \varepsilon < \bar{S} - S_2\right]$$

$$\mathbb{P}[sep] = (1-\rho) + \rho\left[\frac{\bar{S} - S_2 + e}{\bar{R} + 2e}\right]$$

Note that

$$\frac{\partial \mathbb{P}[sep]}{\partial S_2} = \frac{-\rho}{\bar{R} + 2e} < 0$$

The firm's profit maximization problem is:

$$\max_{P_a, S_1, S_2} (2 - \mathbb{P}[sep])\left[f(P_a^N) + f(P_w^N)\right] + \mathbb{P}[sep]f(P) - S_1 - (1 - \mathbb{P}[sep])S_2$$

When firms use NCAs there are no externalities between factors of production, patients and labor. When the firm hires a worker, the firm's referral decision is independent of wages that offered to recruit the worker. Therefore we can first solve the patient referral problem, and then solve the profit maximizing salary offers.

Patient referrals are chosen by solving:

$$\max_{P_a} (2 - \mathbb{P}[sep])\left[f(P_a^N) + f(P_w^N)\right] + \mathbb{P}[sep]f(P) - S_1 - (1 - \mathbb{P}[sep])S_2$$

The FOC is:

$$\frac{\partial \pi}{\partial P_a} = (2 - \mathbb{P}[sep])\left[f'(P_a^N) + f'(P_w^N)\frac{\partial P_w^N}{\partial P_a^N}\right] = 0$$

$$\Rightarrow \quad f'(P_a^{N\star}) = f'(P_w^{N\star}) \quad \Rightarrow \quad P_a^{N\star} = P_w^{N\star} = \frac{P}{2}$$

This solution, along with the concavity of f, gives the first hypothesis of the model:

Hypothesis 1 *Physicians with NCAs will have more patients allocated to them by the practice owner:* $P_w^{N\star} > P_w^{C\star}$.

Notice that since NCAs allow firms to equitably distribute patients, the total output is greater even though all firms use the same inputs.

Corollary 1 *The more equitable distribution of clients made possible by NCAs increases the productive efficiency of firms.*

Given this solution to the referral problem, firms choose salary offers by maximizing

$$\max_{S_1, S_2} (2 - \mathbb{P}[sep])2f(P/2) + \mathbb{P}[sep]f(P) - S_1 - (1 - \mathbb{P}[sep])S_2$$

Plugging in the formula for the probability of separation gives:

$$\max_{S_1,S_2} 4f(P/2) - \left[(1-\rho) + \rho\left[\frac{\bar{S} - S_2 + e}{\bar{R} + 2e}\right]\right][2f(P/2) - f(P) - S_2] - S_1 - S_2$$

subject to the legal constraint on minimum salaries, and the worker's participation constraint:

$$S_1, S_2 \geq \bar{S}$$

$$S_1 + \rho S_2 + (1-\rho)(\bar{S} - R^\star) \geq \bar{S} + f(P_w^{C^\star})$$

The Kuhn-Tucker conditions are:

$$\lambda_1(\bar{S} - S_1) = 0, \quad \lambda_2(\bar{S} - S_2) = 0$$

$$\lambda_3\left[\bar{S} + f(P_w^{C^\star}) - S_1 - \rho S_2 - (1-\rho)(\bar{S} - R^\star)\right] = 0$$

The FOCs with respect to S_1 and S_2, respectively, are

$$-1 + \lambda_1 + \lambda_3 = 0 \quad \Rightarrow \quad \lambda_1 + \lambda_3 = 1 \tag{1}$$

$$\frac{\rho}{\bar{R} + 2e}\left[2f(P/2) - f(P) + \bar{S} - 2S_2 + e\right] - \rho + \lambda_2 + \rho\lambda_3 = 0 \tag{2}$$

As we show in the appendix, the solution occurs when the recruiting constraint binds with equality, and the equilibrium earnings path is:

$$\{S_1^N, S_2^N\} = \left\{\bar{S}, \frac{f(P_w^{C^\star}) - (1-\rho)(\bar{S} - R^\star)}{\rho}\right\}$$

This result directly yields the hypothesis (see Appendix for proof):

Hypothesis 2 *Physicians with NCAs have greater within-job earnings growth, and the earnings growth is due to larger returns to tenure, conditional on experience.*

Intuitively, total earnings growth can be expressed as the sum of returns to experience and returns to tenure. Physicians without NCAs have the same earnings growth regardless of whether they remain at the firm, so the return to tenure conditional on experience is zero. All of the earnings growth is caused by returns to experience. In contrast, if physicians with NCAs separate in the second period they earn $\bar{S}$. Therefore there is zero earnings growth from increasing experience without also increasing tenure. All of the earnings growth occurs within-jobs, and is due to greater returns to job tenure.

3.2 Contracting Frictions, Bargaining, and Earnings

A stylized fact of labor markets, however, is that forward commitments to guaranteed salary increases are rarely observed. If firms cannot credibly commit to a contract specifying a

second-period salary, then NCAs create a bargaining problem. Once a worker has signed an NCA their bargaining position decreases in the second period, since the firm knows that the worker's reservation wage has declined due to the cost of relocating. Without credible forward commitments, workers may demand front-loaded compensation in order to accept a job with an NCA. All else equal, this incentive may force the earnings path to be flatter than the profit-maximizing path derived above. Flattening the earnings path increases the probability of worker separations in the second period, and reduces welfare relative to the equilibrium with credible forward commitments.

Our goal in this section to demonstrate that there exists an incentive compatible revenue-sharing contract in which the loss of ex post bargaining position due to NCAs does not cause distortions that flatten earnings paths, avoiding potential deadweight loss from excess turnover. The existence of such a contract suggests that when turnover is costly to firms, as is the case in the model presented above, then share-based contracts may be Pareto-improving relative to front-loaded or flat compensation paths.

To see this, suppose compensation structures may depend linearly on output:

$$M = S + \alpha f(P_w)$$

where α is the share of output that the worker keeps as compensation. A contract is now defined as (1) first-period compensation, M_1, (2) non-compete agreements $\{N, C\}$, and (3) forward "sticky wage" commitments by the firm to not reduce S or α in the second period. The sticky wage commitment reflects the limited credibility of guaranteed future salary increases, but allows firms to credibly commit to not decreasing either compensation parameter.[15]

To pin down the intuition behind the model equilibrium, suppose there is a small amount of stochasticity in output. We also introduce an upward-sloping output function, by assuming that output grows in the second period at the rate $\delta > 1$. Firms without NCAs have no compelling reason to use revenue-sharing contracts. Since the firm is risk-neutral, they will insure the worker against output shocks by offering the contract $\{S_C^1, \alpha_C^1\} = \{\bar{S}, 0\}$ in period 1. The worker can then re-negotiate the contract in the second period by threatening to separate, $\{S_C^2, \alpha_C^2\} = \{\delta f(P_w), 0\}$.

Workers with NCAs, however, cannot increase their compensation in the second period by threatening to exit, since the worker's expected outside option yields a payoff of only $\bar{S} - \mathbb{E}[R_w]$. Anticipating that their bargaining position will decline in the second period, workers must negotiate an ex ante incentive-compatible contract with fixed compensation components $\{S_N, \alpha_N\}$.

[15] One reason why such a contract may occur is if workers choose effort, and firms are hesitant to commit to second period salary increases due to moral hazard. Facing uncertain effort, firms may be willing to commit to forward share-based contracts even when they would not commit to forward salary levels. For example, with Cobb-Douglas production and variable capital inputs, firms will pay labor a fixed share of output that is independent of effort.

To gain intuition, suppose for simplicity that output shocks are very small, so the profit-maximizing equilibrium earnings path can be approximated by re-solving the model with log utility:

$$\max_{S_1,S_2}(2+\delta)f(P/2) - \left[(1-\rho)+\rho\left[\frac{\bar{S}-S_2+e}{\bar{R}+2e}\right]\right][2\delta f(P/2)-\delta f(P)-S_2] - S_1 - S_2$$

subject to the legal constraint on minimum salaries, and the worker's participation constraint:

$$S_1, S_2 \geq \bar{S}$$

$$\rho\ln(S_1+S_2)+(1-\rho)\ln(S_1+\bar{S}-R^\star) \geq \ln(\bar{S}+\delta f(P_w^{C\star}))$$

When $S_1 = \bar{S}$ and the recruiting constraint binds, the profit maximizing earnings path is

$$\{S_1, S_2\} = \left\{\bar{S}, \frac{\left(\bar{S}+\delta f(P_w^{C\star})\right)^{1/\rho}}{(2\bar{S}-R^\star)^{\frac{(1-\rho)}{\rho}}} - \bar{S}\right\}$$

Now, introducing revenue-sharing contracts, the equilibrium compensation contract $\{S_N, \alpha_N\}$ that matches this profit-maximizing earnings profile must satisfy:

$$S_N + \alpha_N f(P/2) = \bar{S} \tag{3}$$

$$S_N + \alpha_N \delta f(P/2) = \frac{\left(\bar{S}+\delta f(P_w^{C\star})\right)^{1/\rho}}{(2\bar{S}-R^\star)^{\frac{(1-\rho)}{\rho}}} - \bar{S} \tag{4}$$

Equation (3) implies $\alpha_N = \frac{\bar{S}-S_N}{f(P/2)}$. Subtracting (3) from (4) gives:

$$\alpha_N(\delta-1)f(P/2) = \frac{\left(\bar{S}+\delta f(P_w^{C\star})\right)^{1/\rho}}{(2\bar{S}-R^\star)^{\frac{(1-\rho)}{\rho}}} - 2\bar{S} > 0$$

Notice that the RHS is strictly positive, because of the earnings constraint $S_2 > \bar{S}$.[16] The LHS is also strictly positive since $\delta > 1$. This implies $\alpha_N > 0$.

The economic intuition behind this result is straightforward. Although limited credibility constrains the set of contracts, this constraint can be overcome if the firm uses fixed revenue-sharing rates to match the profit-maximizing earnings path that would occur under perfect forward credibility. This equilibrium requires the existence of an upward-sloping function to which α can be tied; growing output, $\delta > 1$, is one natural example of such a function. When this occurs, firms can bundle NCAs with revenue-sharing contracts, which

[16]
$$S_2 > \bar{S} \Rightarrow \frac{\left(\bar{S}+\delta f(P_w^{C\star})\right)^{1/\rho}}{(2\bar{S}-R^\star)^{\frac{(1-\rho)}{\rho}}} > 2\bar{S}$$

allows compensation to increase along with output, without the need to renegotiate contract terms in the second period.

Hypothesis 3 *If long-term forward compensation contracts have limited credibility, and output grows over time, then firms that use NCAs can use share-based compensation contracts in which $\alpha_N^\star > \alpha_C^\star$ to achieve the same profit-maximizing earnings path that would occur under credible forward contracts.*

In this simple model we abstract from explaining which firms choose to use NCAs, and the hedonic equilibrium is driven entirely by sorting on worker preferences. Of course, in a more realistic setting the decision by a firm to impose NCAs is unlikely to be random. For example, firms in geographic markets with fewer patients per physician (lower endowments of P per firm) may derive more benefits from protecting the marginal patient from being poached, increasing $R^\star$, and hence the fraction of employees with NCAs. Similarly, if production is augmented by a persistent productivity shifter $\tau f(P)$, more productive firms may derive greater benefits from NCAs. Finally, if firms differ in hiring costs, higher cost firms may benefit more from NCAs. Although our theoretical discussion abstracts from many of these issues, appropriate interpretation of our empirical estimates depends on the extent to which potentially unobserved factors directly affect both the decision to use NCAs as well as the outcomes of interest in our hypotheses. We return to discuss these selection issues, and the conditions under which our parameter interpretations may be affected by selection, in Section 5.

3.3 Summary of Testable Hypotheses

The goal of our empirical analyses is to test for evidence that physician practices use NCAs to prevent patients from being poaching, protecting firms' investments in client relationships, which we model as intra-firm referral choices in the stylized model above. Our primary analyses test Hypothesis 2, that NCAs increase the rate of return to job-tenure. We test this hypothesis by estimating the relationship between the use of NCAs and within-job earnings growth, and decomposing the earnings growth differential into components due to experience and job tenure.

We also make use of several other predictions from the model to provide corroborating suggestive evidence. Hypothesis 1 is that firms that use NCAs allocate more patients to employed physicians. In the survey data, we are able to observe the distribution of patients to physicians. We test for evidence of disparities in the allocation of patients between employed physicians and those that have equity ownership in the firm. If NCAs reduce referral holdups, firms that use NCAs should have more balanced distributions of patient loads across physicians. In the medical context, however, all patients are not alike. Physicians that treat privately insured patients tend to receive higher reimbursements than than those that treat Medicaid patients, for example. In addition to testing for overall

disparities in the number of clients, we also examine heterogeneity in the allocation of clients by their source of insurance coverage.

Hypothesis 3 is that NCAs may be bundled with share-based compensation incentives to overcome the effects of changes in bargaining position. We use data on the fraction of earnings that come from incentive payments tied to individual production to provide stylized summary statistics on this hypothesis. We also empirically evaluate the alternative hypothesis that physician practices use NCAs solely to reduce job turnover.

4 Data

Our empirical analyses rely primarily on two data sources. The first is a survey of physicians, which to our knowledge is the largest existing dataset that contains micro-level information on the use of NCAs linked to labor-market outcomes. The second dataset quantifies variation in state laws that govern the enforceability of NCAs.

4.1 Physician Survey

We use the Physician Perspectives on Patient Care Survey, which we conducted in 2007,[17] using a sampling frame drawn from the American Medical Association (AMA) Masterfile. The population from which potential respondents were drawn included only primary care physicians (family practice, general practice, general internal medicine, and general pediatrics) in five states, California, Texas, Illinois, Georgia, and Pennsylvania. Using a state-based sample rather than a national survey permitted collection of larger samples from local market areas, and these states were chosen to be representative of a variety of practice environments, while being geographically diverse. The target population excluded residents, fellows, physicians not in clinical practice, and those over 70 years old. Pediatricians and minority physicians were over-sampled.

The AMA database provides information on physician location and contact information, specialty and training, age, and race. Telephone calls verified contact information and whether sample physicians were providing patient care. A multi-mode (mail and web) self-administered survey was conducted. A packet was sent by Federal Express to a total of 2,831 physicians containing a mail survey accompanied by an advance letter, a pre-paid business return envelope and an honorarium check of $100. Physicians were given the option of responding by web. Follow-up was conducted for those physicians who did not respond, with separate follow-up with those who did not respond but cashed their checks. Altogether, a total of 1,967 usable responses were received, 216 (11%) of which were by web. The overall response rate was 69.8%.[18]

[17]We are grateful for funding for the survey provided by the Agency for Healthcare Research and Quality (AHRQ), the California Endowment, and the Commonwealth Fund.

[18]Base sampling weights were assigned to each physician based on the inverse of their probability of selection and then adjusted for the probability of non-response and the probability of being sampled based

The survey questionnaire included detailed questions on the following topics: physician characteristics, practice characteristics, physician demographics, practice financial performance, physician earnings over several years, patient mix, practice administrative controls, average prices negotiated with insurance companies, and patient vignettes to elicit knowledge of clinical guidelines, diagnoses, and treatment recommendations.

One section of the survey that is key to the analyses includes income and revenue generated by each of the respondents. Although the survey was conducted at a point in time, respondents were asked about longitudinal variation in their earnings. This was done by asking for earnings levels in 2005, and then asking by what percentage their earnings differed from 2005 levels in 2006, and three years prior, in 2002. We use responses to these questions to estimate the rate of growth of earnings within jobs. We also observe the year in which each respondent completed medical school, and the year in which they joined their current practice, from which we calculate potential experience (in medical care) and job tenure.

The survey also asks detailed questions about the structure of compensation for each worker. Specifically, it asks "What percent of your 2005 earnings was paid as flat salary?", "What percent of your 2005 earnings was based directly on fees-for-services you provided, or on your productivity?", and "What percent of your 2005 earnings was in the form of pay-outs from withholds, practice bonuses, or other incentive payments, including pay-for-performance bonuses?" We use responses to these questions to estimate how NCAs are related to the use of share-based compensation structures.

Physicians were asked how many medical practices they worked in and their ownership status in their main practice. If they responded they were a sole-owner, the survey proceeded to questions about general practice characteristics. However, if the physician indicated that they were not a sole-owner, they were asked about their employment status and the following question regarding NCAs: "Were you to leave your (main) practice, would you be subject to a non-compete clause?"

A copy of the survey questionnaire containing the wording of all questions is included in the Appendix.

4.2 State NCA Laws

We use data from Bishara (2011) to measure the relative strength of enforceability of NCA laws across different states. The measure was created by analyzing case law in each state, and comparing laws based on eight different dimensions. Each dimension was assigned a weight based on legal knowledge about the relative importance of the dimensions. The specific questions that define the eight dimensions, along with benchmarks for how states were scored and relative weights of each question are included in Appendix Table A2. For example, one important dimension upon which state laws differ is whether NCAs are still

on race.

enforceable in the event that the employer makes the decision to terminate the relationship. In some states NCAs would still be enforceable, while in others NCAs apply only to voluntary separations made by workers.

We normalize the NCA enforceability measures by dividing by the maximum score (Florida, 470), to create a continuous measure between 0 and 1. Appendix Table A3 shows that there is substantial variation in the Bishara (2011) enforceability scores for the 5 states in our sample (CA, GA, IL, PA, TX), which are respectively ranked 50th, 43rd, 4th, 23nd, and 32rd in stringency of enforcement out of 50 states plus DC.

5 Empirical Analyses

We begin by describing stylized summary statistics from the survey data documenting the use of NCAs in physician group practices. We then present our main empirical models and corresponding estimates of the effect of NCAs on within-job earnings growth and the rate of return to tenure in Section 5.2, followed by a variety of suggestive evidence consistent with the hypotheses from Section 3. Section 5.3 documents the relationship between NCAs and job turnover, including back-of-the envelope calculations of minimum hiring costs practices would have to face to justify the estimated earnings differentials if turnover reductions were the sole source of benefits to practices from using NCAs. Section 5.4 presents several robustness analyses, including evidence against the threat of selection on unobservables, and potential correlations between state NCA enforceability laws and other state-level policies.

5.1 Summary Statistics on NCA Use

Table 1 reports the share of physicians with employment contracts that contain NCAs in each state in our sample. The use of NCAs varies substantially across states, ranging from 31.3% in California to 60.6% in Pennsylvania, with an average of 45.1% of all physicians in group practices in the sample subject to an NCA. This variation in usage is consistent with differences in enforceability—physicians are more likely to have contracts with NCAs if they work in states in which NCAs are more enforceable.

Table 1: % of Respondents with NCAs, By State and Employment Status

	Full Sample		Employees		Part Owners	
California	512	31.3%	241	30.3%	224	34.8%
Georgia	120	51.7%	56	60.7%	57	45.6%
Illinois	217	52.1%	127	50.4%	81	56.8%
Pennsylvania	231	60.6%	158	66.5%	68	51.5%
Texas	269	49.4%	141	56.7%	104	43.3%
All States	1347	45.1%	723	49.2%	534	43.1%

NCAs are also used more frequently on physicians who are employees (49.2%) rather than part-owners (43.1%) of a practice. Part-owners have some deterrent to competing against their current practice because doing so could devalue their share of the practice's equity, which may be a relatively illiquid investment.[19]

Given the lack of prior evidence documenting how prevalent NCAs are in physician groups, one may expect that NCAs are a relatively recent phenomenon in physician organizations. Table 2 suggests that this is not the case—the probability that physician in the sample is bound by an NCA is fairly stable across all levels of physician experience and practice tenure.

Table 2: % of Employees with NCAs, By Potential Experience and Practice Tenure

	Tenure				
Potential Experience	1 to 7	8 to 14	15 to 21	22+	Total
1 to 7	49.4%				51.4%
8 to 14	37.1%	55.6%			47.0%
15 to 21	41.5%	49.2%	59.6%		49.0%
22+	42.4%	47.1%	47.6%	47.4%	45.6%
Total	44.1%	54.2%	55.3%	50.0%	48.6%

Notes: Sample includes physicians who are employees and are not part-owners of the practices at which they work, and who completed medical school since 1980.

Since understanding why practices differ in the use of NCAs requires first knowing what motivates practices to use NCAs, our main question of interest in this study, we begin by simply documenting summary statistics on the use of NCAs by practice type. Table 3 describes the heterogeneity in the percentage of physicians in group practices that are bound by NCAs.

The first notable pattern in the table is that NCAs are quite common in every specialty, practice type, demographic group, and geographic market. There is relatively little variation across specialties within our sample of primary care physicians, ranging from 41% of physicians with two or more specialties, to 46% for pediatric specialists. There is, however, some variation across practice settings, with 50% of office-based physicians having NCAs, compared to only 37% of physicians employed at hospitals or free-standing care centers. This pattern is consistent with the hypothesis that NCAs are more likely to be used in settings in which ongoing patient-doctor relationships are more valuable. The least likely group to have signed NCAs are physicians who are independent contractors.

The last group of summary statistics shows that there is relatively little variation in NCA use by demographics, or by characteristics of the geographic market in which the practice is located. However, there is substantial variation in NCA use across states. In

[19]Note that states also differ in their legal treatment of the enforceability of NCAs on employees versus owners.

Table 3: Heterogeneity in Percentage of Physicians in Group Practices with NCAs

	Percent	Sample Size
Internal Medicine	44%	319
Pediatrics	46%	614
Secondary Specialty	41%	293
Office-Based	50%	956
Hospital or Care Center	37%	248
Large Practice (25 Plus)	39%	304
Multi-Specialty Practice	49%	778
Part Owner of Practice	43%	534
Independent Contractor	24%	90
Male	44%	776
Above Median Job Tenure	45%	663
US Med School Graduate	47%	1,088
Employed Spouse	43%	808
County Above Median Income	45%	658
County Above Median Population	40%	703
County Above Median Uninsured Rate	43%	691

Note: Percentages are all conditional on working in a group practice. See Appendix Table A8 for estimates that account for selection into group practices.

Appendix Table A8 we estimate the marginal effect of the Bishara Score on the probability of having an NCA, and show that state enforceability is strongly predictive of NCA use. An increase in enforceability from the least restrictive state (ND) to the most restrictive state (FL) is associated with a 32 percentage point increase in the probability that a physician will have an NCA. This suggests that firms consider state laws to be important factors in calculating the expected benefits to imposing NCAs. It is also worth noting that although employment-based NCAs are virtually unenforceable in California, we still find that 31% of physicians in group practices have signed them. This may suggest that some practices use NCAs simply as deterring threats, even when they are not enforceable.

5.2 Do Physician Practices Use NCAs to Deter Poaching?

We begin by estimating the impact of NCAs on earnings growth and the rate of return to job tenure. These analyses are based on Hypothesis 3 from Section 3, which suggested that if practices were motivated by deterring the risk that patients may be poached by exiting physicians, NCAs should increase the rate of return to tenure, indicative of an increase in firm-specific human capital investments. We use both extensive-margin variation in the use of NCAs, and intensive-margin variation state-level NCA enforceability laws, to show that NCAs increase the rate of return to tenure, and that this effect appears to be driven by state NCA policies rather than selection. We also provide a variety of suggestive stylized

summary statistics that are consistent with the other predictions from Section 3, although our main results come from the longitudinal models of earnings differentials.

5.2.1 Main Results: Within-Job Earnings Growth

We estimate the impact of NCAs on the components of earnings growth using a two-step model similar to Topel (1991). The challenge to decomposing earnings growth is that there are several forms of potential endogeneity to consider. To see this, we first consider a naive OLS model:

$$Y_{ijt} = \alpha + x_{it}\beta_1 + e_{it}\beta_2 + e_{it}NCA_{ij}\beta_3 + T_{ijt}\beta_4 + T_{ijt}NCA_{ij}\beta_5 + NCA_{ij}\beta_6 + \varepsilon_{ijt} \quad (3)$$

where the earnings of physician i at firm j in period t, Y_{ijt}, depend on observable characteristics of the worker and firm, x_{it}, the (potential) experience of the worker, e_{it}, measured in the data as the number of years since graduating from medical school, and the tenure of the worker at firm j, T_{ijt}. The model allows the returns to experience and tenure to depend on whether the worker has an NCA. The well-known problem with this model, however, is that frictional job search or matching may cause the error term to be correlated with experience and/or tenure. Specifically, suppose the error term contains the following components:

$$\varepsilon_{ijt} = \mu_i + \phi_j + u_{ijt}$$

where μ_i is an unobserved worker effect, ϕ_j is an unobserved firm effect, and u_{ijt} is a statistical residual. A correlation between latent firm effects and experience or tenure could arise, for example, in a model of frictional search in which workers climb a job-ladder while searching for jobs at firms that pay higher wages. In this model, experience provides more time over which matching can occur, inducing a correlation with ϕ_j. In addition, once a worker has acquired a job at a high wage firm they are less likely to depart, causing correlation between tenure and ϕ_j.

To understand the potential correlation between unobserved firm wage effects and experience or tenure, consider the error decomposition:

$$\phi_j = e_{it}b_2 + e_{it}NCA_{ij}b_3 + T_{ijt}b_4 + T_{ijt}NCA_{ij}b_5 + \nu_{ijt} \quad (4)$$

This decomposition suggests that endogenous mobility or job-search behavior based on unobserved factors that affect firm-level pay may bias estimates from Equation 3, and the magnitude of the bias may be correlated with NCAs. The direction of the bias in the naive model caused by these correlations is ambiguous. For example, one concern is that ϕ_j and T_{ijt} may be positively correlated if workers tend to stay in high wage jobs. However, the correlation could also depend on total experience if workers with low tenure but high experience are likely to have switched jobs because they found a match with a high ϕ_j,

causing the net bias to be ambiguous.

The objective of the two-step model is to estimate β_3 and β_5 in a way that is robust to these potential forms of endogenous sorting into jobs based on unobserved firm-level characteristics that are correlated with earnings. The first step of the model identifies total earnings growth using longitudinal within-job variation in earnings.

$$Y_{ijt} = e_{it}\beta_2 + e_{it}NCA_{ij}\beta_3 + T_{ijt}\beta_4 + T_{ijt}NCA_{ij}\beta_5 + \Psi_{ij} + \widetilde{\varepsilon}_{ijt} \tag{5}$$

where Ψ_{ij} denotes a fixed effect for each job, or worker-firm pair. We estimate two specifications of this model in which NCA_{ij} is either a binary indicator of NCA use, or is interacted with the continuous Bishara Index of NCA enforceability. The limitation of this model is that, since experience and tenure increase at the same rate over time within most jobs, only the total rate of earnings growth is identified. For physicians without NCAs the estimated rate of growth is $(\beta_2 + \beta_4)$, and the total effect of NCAs on earnings growth is identified by $(\beta_3 + \beta_5)$.[20]

To separately estimate the returns to tenure, β_5, and returns to experience, β_3, we follow the strategy from Topel (1991) by considering the model:

$$Y_{ij} = e_{0i}\beta_2 + e_{0i}\beta_3 NCA_{ij} + T_{ij}B_4 + T_{ij}NCA_{ij}B_5 + NCA_{ij}\beta_6 + \xi_{ij} \tag{6}$$

This model is estimated using information about the level of experience each worker had prior to beginning their current job, which is not collinear with the additional experience and tenure acquired on the job, to separate the two components. e_{0i} denotes the prior experience of worker i at the beginning of the job spell. In this model, B_4 captures the combined effect of tenure and experience acquired at firm j on earnings, which is equivalent to $(\beta_2 + \beta_4)$, and similarly B_5 captures the effect of NCAs on earnings growth, equivalent to $(\beta_3 + \beta_5)$. Since B_4 and B_5 are identified in Model 5, they can be subtracted from both sides of Equation 6 to construct the second stage of the model:

$$Y_{ij} - T_{ij}\widehat{B_4} - T_{ij}NCA_{ij}\widehat{B_5} = e_{0i}\beta_2 + e_{0i}NCA_{ij}\beta_3 + NCA_{ij}\beta_6 + \epsilon_{ij} \tag{7}$$

where

$$\epsilon_{ij} = \xi_{ij} + T_{ij}(B_4 - \widehat{B_4}) + T_{ij}NCA_{ij}(B_5 - \widehat{B_5})$$

[20]Similar intuition can be seen by considering the first-differences analog of this specification. For workers with NCAs, taking differences in earnings within-jobs identifies

$$Y_{Nijt} - Y_{Nijt-1} = \beta_2 + \beta_3 NCA_{ij} + \beta_4 + \beta_5 NCA_{ij} + u_{ijt} - u_{ijt-1} + \nu_{ijt} - \nu_{ijt-1}$$

For workers without NCAs:

$$Y_{Cijt} - Y_{Cijt-1} = \beta_2 + \beta_4 + u_{ijt} - u_{ijt-1} + \nu_{ijt} - \nu_{ijt-1}$$

The difference in within-job earnings growth associated with NCAs is estimated by the term $(\widehat{\beta_3 + \beta_5})NCA_{ij}$.

Equation 7 provides unbiased estimators $\widehat{\beta_3}$ and $\widehat{\beta_5} = \widehat{B_5} - \widehat{\beta_3}$ under the assumption $\mathbb{E}[e_{0i}\xi_{ij}] = 0$. This assumption, however, is directly testable. A violation of the assumption would occur if e_{0i} was correlated with the error term in the second stage equation. Suppose ϕ_j was a component of the error term, creating endogeneity in the estimated rate of growth of earnings due to unobserved firm characteristics, such as managerial ability. Inserting ϕ_j from Equation 4 into Equation 7 gives:

$$\begin{aligned} Y_{ij} - \; & T_{ij}\widehat{B_4} - T_{ij}NCA_{ij}\widehat{B_5} \\ = \; & e_{0i}\beta_2 + e_{0i}NCA_{ij}\beta_3 + NCA_{ij}\beta_6 + T_{ij}(b_2 + b_4) + T_{ij}NCA_{ij}(b_3 + b_5) + \epsilon_{ij} \quad (8) \end{aligned}$$

where T_{ij} is the accumulated tenure and experience on the job. This equation shows that the endogeneity bias in the estimated rate of earnings growth caused by systematic job changes that are correlated with unobserved practice characteristics is equal to the sum $b_2 + b_4$, and the impact of NCAs on this bias term is equal to the sum $b_3 + b_5$. Each of these sets of coefficients is identified by reinserting $T_{ij}(b_2 + b_4) + T_{ij}NCA_{ij}(b_3 + b_5)$ back into the right hand side of the second stage, and re-estimating the model. If systematic job mobility based on observed practice characteristics were an important component of earnings growth, or if NCAs increased this rate of earnings growth or the rate of improvement in match quality over time, then T_{ij} and $T_{ij}NCA_{ij}$ would have positive and significant coefficients in this model. The impact of this positive mobility bias would lead β_2 and β_3 to be upper bound estimates of the rates of return to experience, and β_4 and β_5 to be lower bound estimates of the rates of return to tenure. As reported in Table 5, we fail to reject the assumption that $\mathbb{E}[e_{0i}\xi_{ij}] = 0$, and show empirically that the bias in the estimated rate of earnings growth associated with endogenous sorting on unobserved practice characteristics, or with correlations between NCA use and unobserved practice characteristics, is small, with a maximum value of 1.3 percentage points, 7% of the main coefficient of interest.

Table 4 presents estimates of total within-job earnings growth from Equation 5. The model is estimated as a fixed effects specification with job-match effects, using three years of earnings data per physician.[21] The estimates suggest that total within-job earnings growth is fairly small and statistically insignificant for physicians without NCAs in both specifications. However, for physicians with NCAs, within-job earnings growth is significantly higher. Column 1 presents estimates of the first stage model using extensive margin variation in NCA based on which physicians have signed NCAs, and first-order coefficient on NCA*Job Tenure is 0.19. Column 2 presents estimates from a similar model that uses intensive margin variation in state-level policies by interacting NCA use with the Bishara Score, and the first-order coefficient remains statistically significant and increases slightly, to 0.25.

[21] Some respondents have fewer than three years of data because we exclude earnings from jobs prior to the physician's current job at the time of survey.

Table 4: Fixed Effects Models: Within-Job Earnings Growth

	(1) Binary NCA		(2) Continuous Bishara Score*NCA	
	β	SE	β	SE
NCA*Job Tenure	0.19***	[0.07]	0.25***	[0.10]
NCA*Job Tenure Sq. (÷ 10)	−0.04	[0.06]	−0.07	[0.09]
NCA*Job Tenure Cu. (÷ 100)	0.03	[0.03]	0.05	[0.05]
NCA*Job Tenure 4th (÷ 1000)	−0.01	[0.01]	−0.01	[0.01]
NCA*Potential Exp. Sq. (÷ 10)	−0.23***	[0.08]	−0.27***	[0.10]
NCA*Potential Exp. Cu.(÷ 100)	0.11***	[0.04]	0.12**	[0.05]
NCA*Potential Exp. 4th (÷ 1000)	−0.02***	[0.01]	−0.02**	[0.01]
Job Tenure	0.03	[0.04]	0.05	[0.04]
Job Tenure Sq. (÷ 10)	−0.01	[0.04]	−0.01	[0.04]
Job Tenure Cu. (÷ 100)	−0.01	[0.02]	−0.01	[0.02]
Job Tenure 4th (÷ 1000)	0.00	[0.00]	0.00	[0.00]
R Sq.	0.96		0.96	
N	2281		2281	

Notes: All models include job-match effects (which absorb the base NCA effect) and quadratic, cubic, and quartic potential experience. In column 1 'NCA' is a binary measure, and in column 2 'NCA' refers to the interaction between the binary indicator and the Bishara Score. Dependent variable is annual earnings, observed in up to three years over a five year window between 2002 and 2006. Sample includes physicians below age 65 who worked at least 200 hours annually. Standard errors, clustered by Primary Care Service Area, in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

To be clear, this first-order coefficient is a linear approximation of a nonlinear function of experience and tenure in the neighborhood of zero years of each. The total rate of earnings growth declines rapidly after the first year on the job, as shown in the bottom panel of Table 5, which reports the predicted annual rate of earnings growth by year of tenure implied by the estimates. For example, the fifth year of tenure is predicted to increase earnings among those with NCAs by 6.2%, compared to a 4.0% increase for physicians without NCAs.

Table 5 presents the remaining estimates of the two-step model. The first column includes estimates of β_2 and β_3 from Equation 7. The second column repeats the coefficient estimates from Table 4, which come from estimating Equation 5. The third column reports the main estimates of the effect of NCAs on the rate of return to tenure, which is identified jointly by the estimates from columns one and two. The fourth column presents estimates from Equation 8 of the bias components that may arise if job mobility is endogenous in the sense that the rate of earnings growth is correlated with unobserved firm characteristics, ϕ_j.

The second-step model suggests that mean returns to experience associated with NCAs

Table 5: Main Estimates of Effect of NCAs on Return to Experience and Tenure

	Experience Effect	Within-Job Earnings Growth	Tenure Effect	Wage Growth Bias
	$\underline{\beta_2}$	$\underline{\beta_2 + \beta_4}$	$\underline{\beta_4}$	$\underline{b_2 + b_4}$
Main Effect	0.029	0.031	0.002	-0.004
	(0.028)	(0.042)	(0.041)	(0.007)
	$\underline{\beta_3}$	$\underline{\beta_3 + \beta_5}$	$\underline{\beta_5}$	$\underline{b_3 + b_5}$
Main Effect*NCA	-0.015	0.194 ***	0.209 ***	0.013
	(0.092)	(0.073)	(0.030)	(0.012)
	$\underline{\beta_3}$	$\underline{\beta_3 + \beta_5}$	$\underline{\beta_5}$	$\underline{b_3 + b_5}$
Main Effect*Bishara Score	-0.050	0.253 ***	0.303 ***	0.024
	(0.264)	(0.096)	(0.105)	(0.021)

Within-Job Earnings Growth Implied by Estimates, by Year of Tenure

	Year of Tenure									
	1	2	3	4	5	6	7	8	9	10
Without NCA	0.033	0.037	0.039	0.040	0.040	0.038	0.036	0.033	0.029	0.025
With NCA	0.201	0.158	0.120	0.089	0.062	0.041	0.023	0.010	0.001	-0.006

Notes: Estimates of within-job earnings growth are from Table 4. The second step model includes Primary Care Service Area effects and controls for physician specialty, practice setting, ownership status, gender, foreign medical school graduate, race, and firm size variables. Sample includes physicians with positive earnings who reported working at least 200 hours annually. All standard errors, reported in parentheses, are the larger of estimates clustered by Primary Care Service Area and estimates clustered by state, which were calculated using the Cameron, Gelbach, and Miller (2008) wild cluster bootstrap-t method. ** $p < 0.05$, *** $p < .01$. Predicted annual rates of within-job earnings growth for a new physician entering a practice with zero years of tenure and zero years of experience, based on estimates reported in Table 4 Model 1.

are close to zero, which implies a rate of return to tenure of 20.9% in the first year.[22] All reported standard errors are whichever is larger between the standard error clustered by state and estimated using the Cameron et al. (2008) wild cluster bootstrap-t method, and the standard error clustered by Primary Care Service Area (PCSA), a market definition from the Dartmouth Atlas of Healthcare. The estimated bias induced by correlation between e_{0i} and ξ_{ij} is quite small, 0.013, or about 7% of the total earnings growth.

The third row of the table presents our main estimates identified by the combination of extensive-margin use of NCAs and intensive-margin variation in state NCA enforceability.

[22] Altonji and Williams (2005) and Nevos and Waldman (1997) debate the sensitivity of estimates of returns to tenure to model specifications. Altonji and Williams (2005) replicate the estimates from Topel (1991) and show that when years of tenure are matched to annual earnings rather than lagged earnings, and observations with tenure equal to zero are included, the estimates fall by 43%. We use this specification from Panel C in Table 3 of Altonji and Williams (2005). We also follow Altonji and Williams (2005) in removing year effects before the first stage model rather than using the detrending procedure in Topel (1991). Our estimates are also not sensitive to other specific data concerns raised in this debate, including union effects and marital status.

The estimated rates of total earnings growth and return to tenure are slightly larger than the estimates in the second row, and again suggest that the difference in the rate of earnings growth associated with NCAs is attributed to larger returns to tenure.[23]

The bottom of the table shows the rates of earnings growth implied by estimates from column 1 of Table 4 by year of tenure and experience. Although physicians with NCAs have much larger initial rates of earnings growth, the predicted cumulative earnings gain over the first 10 years among those with NCAs is 70%, compared to 35% for physicians without NCAs. The comparable estimates are 89% and 36%, respectively, in the model using variation in state enforceability.

By demonstrating that nearly all earnings growth comes from larger returns to job tenure, these estimates provide evidence on the nature of the human capital investments that firms make that could lead to this differential earnings growth. The results imply that these investments are firm-specific, such as within-firm patient referrals (which are made firm-specific by NCAs), consistent with Prediction 3 in our model.

Of course, there are potential threats to identification in this model. One concern is that practices run by higher ability managers may be more likely to use NCAs, and may also be more productive and pay higher earnings. This form of potential bias is captured in the estimated wage growth bias components in Table 5, which indicate that there is little correlation between practice unobservables, such as managerial ability, and either the rate of earnings growth or the use of NCAs. Moreover, we also estimate a version of the two-step model in which the NCA variable is continuous, which identifies the wage growth components using state variation in NCA enforceability measured by the Bishara Score. In this specification we still fail to reject the null hypothesis that unobserved practice characteristics are uncorrelated with earnings growth or NCA use, but this specification also narrows the potential scope for such endogeneity bias, which would require, for example, that physicians who are more talented managers avoid states in which NCAs are harder to enforce. Empirical evidence suggests that this is unlikely to be true: Yett and Sloan (1974) study physician location choices and show that physicians tend to practice medicine in either the state in which they were born, or the state in which they attended school or completed a medical residency. Moreover, physicians provide services that are local in geographic nature, and there are tens of thousands of physicians in every state in our sample.

To more formally evaluate this potential concern, we test whether physician practice location choices are correlated with changes in NCA enforceability using the CMS MPIER file, which contains a complete census of the population of physicians in the US from 1996-

[23]We also test whether these differences in the rate of return to tenure can be explained by variation in hours worked. To do this, we re-estimate the models presented in Table 5, but scale accumulated tenure and experience relative to a full-time equivalency baseline. We define a full-time equivalent (FTE) year of work to be the sample average number hours worked per week times the number of weeks worked per year, which equals 2170 hours per year. The estimated rates of return to tenure in this specification are 0.176 in row 2 (SE 0.042), and 0.258 in row 3 (SE 0.066).

2007. We link the MPIER file to a longitudinal version of the NCA Bishara Index that includes the timing of all law changes in each state, developed by Lavetti and Hausman (2017). We then regress the log physician-to-population ratio in each county on the lagged NCA enforceability, county fixed effects, year fixed effects, and log per capita income. The results, reported in Appendix Table A4, show that changes in state NCA laws have no economically or statistically significant effect on the supply of physicians. The estimates suggest that changing NCA laws from a Bishara Score of 0 to 1, the two most extreme observed policies, is predicted to decreases the number of physicians per 1,000 population by only 3% (SE 2.8%), as reported in Appendix Table A4. Moreover, omitting NCA laws from the model of physician supply reduces the R-squared from 0.881 to 0.879, and increases the adjusted R-squared, suggesting that NCA laws have little conditional explanatory power in affecting the location choices of physicians. Starr (2015) also reaches a similar conclusion based on evidence from a broader sample of firms. He tests whether firms that produce tradeable goods choose to locate in states with different NCA policies than those that produce non-tradeable local goods and services, where location choices are less flexible, and finds no effect of NCA policies on location decisions.

We also test for potential correlation between the use of NCAs and physician quality, which we discuss in greater detail in Section 5.4.1. We again find no evidence of sorting on quality, providing some reassurance that several forms of potential selection into NCA contracts appear to be unlikely. Of course, we cannot rule out all forms of potential selection. Although the model accounts for fixed unobserved worker and firm heterogeneity, including potential impacts of unobserved firm characteristics on the rate of earnings growth, as with most fixed effects specifications it cannot account for all forms of potential time-varying unobservables. For this reason, in addition to these primary results, the remainder of the paper presents a variety of corroborating stylized evidence. Although we do not interpret this supporting evidence as causal, it helps corroborate the systematic pattern of evidence consistent with the theory presented in Section 3.

5.2.2 Suggestive Corroborating Evidence

Across-Job Earnings Differentials: Although we have focused on earnings growth differences associated with NCAs, hedonic wage theory also suggests that earnings levels should also be higher in jobs with NCAs. To show the conditional mean difference in average earnings associated with NCAs, which we view only as corroborating suggestive evidence, we estimate the following fixed effects model:

$$Y_{ijm} = \alpha + \gamma_1 NCA_{ij} + \gamma_2 x_{ij} + \theta_m + \varepsilon_{ijm} \tag{2}$$

where Y_{ijm} is the log hourly earnings of physician i at firm j in market m; NCA_{ij} is either a binary indicator or interaction between NCA and enforceability; X_{ij} includes characteristics

of the worker, such as gender, experience, medical school location, tenure, specialty, and equity status, and characteristics of the firm, such as the number of physicians, university affiliations, and whether the practice is multi-specialty; and θ_m is a fixed PCSA market effect.

Table 6: Fixed Effects Wage Models

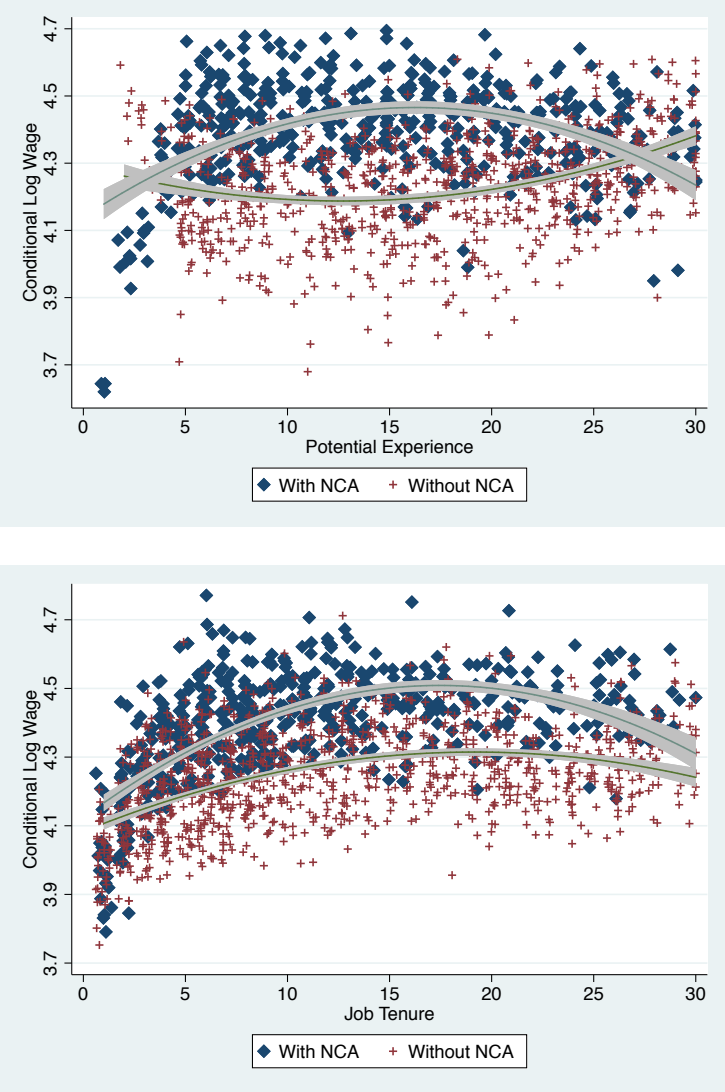
	Dep Var: Log Hourly Earnings					
	(1)		(2)		(3)	
	β	SE	β	SE	β	SE
NCA	0.131 **	[0.060]	0.977 **	[0.393]	−1.368 **	[0.532]
NCA*Log Exp.			−0.359 **	[0.145]	1.391 ***	[0.456]
Bishara Score*NCA			−1.252 **	[0.502]		
Bishara Score*NCA*Log Exp			0.548 ***	[0.186]		
NCA*Log Exp. Sq.					−0.296 ***	[0.096]
Log Tenure	0.199	[0.135]	0.193	[0.135]	0.213	[0.135]
Log Tenure Sq.	−0.034	[0.036]	−0.030	[0.035]	−0.039	[0.036]
Log Exp.	0.171	[0.208]	0.153	[0.229]	−0.766 *	[0.393]
Log Exp. Sq	−0.034	[0.047]	−0.026	[0.047]	0.157 *	[0.082]
R Sq.	0.490		0.503		0.501	
N	877		877		877	

Notes: All models include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care, gender, specialty, practice type, practice size, patients per week, ownership status, and US Medical School graduate indicators. See Appendix Table A5 for full set of estimates. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. White-Huber standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Table 6 presents estimates of Equation 2. The first column shows that the average conditional hourly earnings of physicians with NCAs are about 13% higher. The second column includes a continuous measure of NCAs that accounts for variation in state enforceability interacted with a binary NCA indicator, and interacted with experience to test whether earnings rise faster for physicians with NCAs in states where NCAs are easier to enforce. Since it is difficult to interpret each coefficient on its own, Figure 1 graphically depicts the predicted wage profiles from column 3.

The upper figure graphs the predicted wage profile as a function of potential experience for physicians with and without NCAs, and the lower panel graphs similar tenure profiles. There are two notable features of these graphs: first, hourly earnings of physicians with and without NCAs are similar at the beginning of a career or a new job. Second, earnings rise faster over time in jobs with NCAs. After about 15 years of either potential experience or job tenure, hourly earnings of workers with NCAs are over 20 log points higher than observably similar workers without NCAs. Although these estimates do not account for unobserved worker heterogeneity and job-matching, as the panel-based estimates do, they provide corroborating evidence that the increase in the rate of earnings growth documented in Section 5.2.1 leads to differences in hourly earnings levels.

Figure 1: Cross-Sectional Wage Profiles, by Experience and Tenure



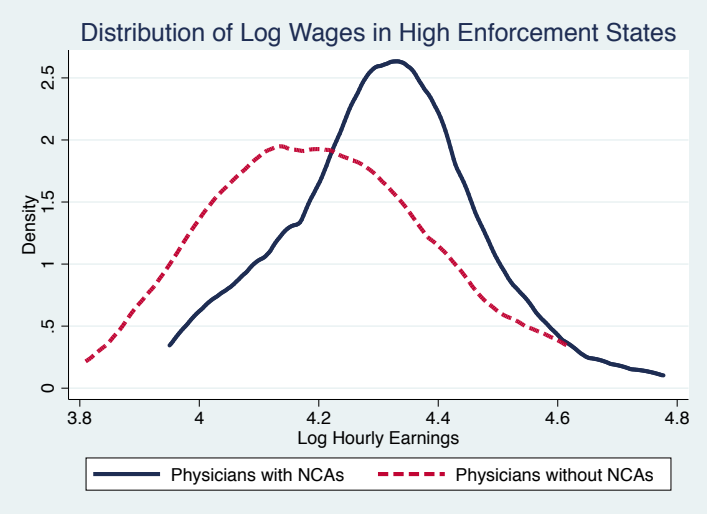
Notes: Vertical axis is expected hourly earnings conditional on PCSA effects and covariates in Model 3 in Table 6 (top), and with tenure instead of experience interacted with NCA (bottom). Sole owners are excluded. Lines are best-fitting quadratic functions, with 95% confidence intervals.

Figure 2 shows kernel density distributions of conditional hourly earnings for physicians with and without NCAs, in low enforceability states compared to high enforceability states. In Figure 2a there is a large positive shift in the distribution of hourly earnings for physicians with NCAs, however as Figure 2b shows, there is no such shift when NCAs are very difficult to enforce.

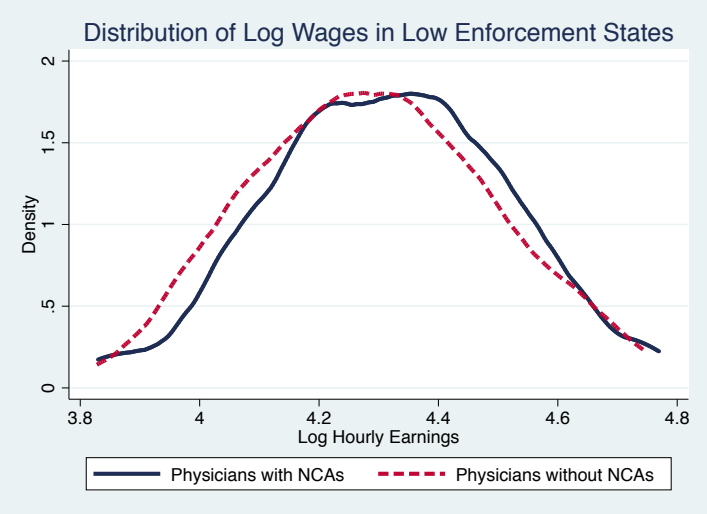
The compensating differentials framework can be useful for understanding why earnings effects of NCAs may be larger in states where NCA enforceability is higher. If workers have heterogeneous preferences for occupational mobility, theory suggests they will sort into jobs with NCAs according to these preferences, and the equilibrium wage differential will be

Figure 2: Kernel Density of Log Hourly Earnings Distribution

(a) High Bishara Score



(b) Low Bishara Score



Notes: Graph displays the kernel density of the predicted hourly earnings distribution conditional on county effects, physician specialty, practice type, practice size, experience, experience squared, ownership status, gender, and race. High enforceability defined as Bishara Score above 0.8, which includes Illinois, and low enforceability defined as Bishara Score below 0.2, which includes California.

determined by the preferences of the marginal worker. If more workers are bound by NCAs in a market, the marginal worker ought to be more averse to accepting an NCA, increasing the observed wage premium. Summary statistics suggest that in states where NCAs are easier to enforce, firms are more likely to use them, consistent with earnings differentials being larger in high enforceability states.

Evidence from Compensation Structures:

Table 7: NCAs and Compensation Structure

	NCA	No NCA
% Earnings from Flat Salary	62.6%	80.1%
(S.E.)	(2.8%)	(2.1%)
% Earnings from Individual Productivity	31.2%	15.1%
(S.E.)	(2.7%)	(1.9%)
% Earnings from Other Incentive Payments	5.5%	4.0%
(S.E.)	(0.7%)	(0.7%)

Notes: 'Earnings from Individual Productivity' are based on responses to the question: "What percent of your 2005 earnings was based directly on fees-for-services you provided, or your own productivity?" 'Earnings from Other Incentive Payments' are based on responses to the question: "What percent of your 2005 earnings was in the form of pay-outs from practice withholds, practice bonuses, or other incentive payments, including pay-for-performance bonuses?" Sample includes physicians who were employees below the age of 65 who worked at least 200 hours at the job in question during in the year.

Prediction 2 from our model is that physicians with NCAs have compensation contracts that are more strongly tied to individual output. Table 7 shows summary statistics on compensation components in the survey data. We find that physicians with NCAs receive about 62% of their total annual income as guaranteed fixed salary, compared to 80% of income for physicians without NCAs. Consistent with our prediction, the share of total earnings that is tied to individual productivity is more that twice as high for physicians with NCAs, 31.2% compared to 15.1%. The disparity in the *level* of individual incentive payments in even larger, since physicians with NCAs earn more on average. Other incentive payments tend in the same direction, accounting for about 5.5% of total earnings for physicians with NCAs and 4.0% for physicians without.

Although our theoretical model focuses on the role of incentive pay in generating upward-sloping earnings paths despite the reduction in bargaining power caused by NCAs, the literature more broadly has discussed several alternative explanations for the use of incentive pay in physician compensation. Ellis and McGuire (1986) develop a model of physician behavior under alternative compensation structures. They show that fee-for-service reimbursement, which is more strongly incentive-based, can lead to overutilization of services, while purely prospective reimbursement, which is less incentive based, can lead to underutilization if physicians care sufficiently strongly about profits relative to patient welfare. They conclude that a mixed reimbursement system in which physicians have incentives that are only partially linked to services provided can be superior, and prevent underutilization of care. In this model, incentive pay primarily affects the quantity of services provided because physicians are assumed to have perfect control over quantity as agents of their patients. The model suggests that physicians who more strongly value patient welfare relative to profits have less need for incentive pay.

To help interpret the observed difference in incentive pay associated with NCAs, we

test whether these alternative theories of incentive pay from the literature can explain the patterns we observe. The models in Ellis and McGuire (1986) and Clemens and Gottlieb (2014) suggest that incentive pay should be lower among more altruistic physicians who are less motivated by profits. Our survey data contain several questions related to providing charity care. In Appendix Table A7 we show that the gap in incentive pay associated with NCAs cannot be explained by controlling for these measures of altruism, by observed physician and practice characteristics, or by geography. Relative to the unconditional mean difference in the share of earnings tied to individual production of 18.5%, the difference drops to 16.1% after conditioning on the full set of controls.

One additional potential concern is that incentive pay may be used in areas with relatively low supply of physicians to encourage doctors to work more hours. However, we find that NCAs are less common in areas with low supply, suggesting that this explanation is unlikely to drive the observed patterns in incentive pay. Specifically, we find that in counties in which less than 20% of the population lives in an urban area, which tend to be areas with low physician supply, NCAs are 6% less likely to be used.

Another possible alternative explanation for this pattern is discussed in Gaynor and Gertler (1995), who argue that in partnerships the influence of productivity on earnings could be motivated in part by risk protection. This suggests that if firms using NCAs tend to be smaller, earnings may be more directly influenced by productivity because there are fewer physicians over which to smooth fluctuations in output. However, Table 8 shows that very small practices with 2-3 physicians are less likely to use NCAs (31%) than practices with 4-499 physicians (45-50%).

Table 8: NCA Use by Firm Size

	All Physicians		Employees Only	Part-Owners
	Mean	N	Mean	Mean
2 to 3 Physicians	31.3%	319	61.2%	15.4%
4 to 9 Physicians	50.2%	420	55.3%	45.4%
10 to 99 Physicians	45.0%	289	40.8%	55.1%
100 to 499 Physicians	44.8%	105	46.2%	46.0%
500+ Physicians	9.4%	149	45.5%	2.5%

Notes: Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old.

Evidence from Patient Allocations and Generated Revenue: For evidence on Prediction 1, that firms using NCAs have more intra-firm patient referrals, we look directly at client allocations and worker-level revenue within firms. Table 9 shows the mean number of weekly patient visits for employees and practice owners with and without NCAs. Employed physicians with NCAs see over 11% more patients per week than those without NCAs, while the number of patients seen by practice owners does not vary much with NCA use. How-

ever, even more important differences underlie these totals—the composition of patients by source of insurance coverage is also substantially affected by NCA use. Physicians with NCAs have substantially more privately insured patients and Medicare patients, which have the highest reimbursement rates, but treat fewer patients with Medicaid coverage or no insurance.[24] Medicaid payment rates averaged roughly half of the private insurance rates in our data.

We also estimate the weekly revenue generated by each physician using data on the number of patients served, the shares of patients covered by private insurance, Medicare, and Medicaid, and the associated reimbursement rates from each insurer. For privately insured patients, data on negotiated reimbursement prices are based on responses to the survey question: "On average, what is your net fee after discount for an initial office visit with a private, commercially-insured patient?" Similarly, we apply reimbursement rates in the corresponding geographic area for primary care services to new patients making initial visits who are insured by Medicare or Medicaid.[25] Although this estimated revenue index cannot account for unobserved variation in the mixture of services provided by different physicians, it does provide an estimate of the effect of variation in the absolute number of patients as well as the composition of patients across physicians.

Table 9: Patient Stocks, Revenue, and Hours

	Employees		Owners	
	Without NCA	With NCA	Without NCA	With NCA
Total Patient Visits (Weekly)	87.1	96.8	112.1	110.4
Privately Insured	41.9	52.8	61.3	78.0
Medicare	13.3	17.6	22.8	14.2
Medicaid	21.9	19.2	20.9	11.5
Uninsured	9.8	7.1	7.4	5.2
Estimated Weekly Revenue Generated	\$6,637	\$8,964	\$8,253	\$9,246
Hours of Patient Care per Week	34.7	38.6	41.7	38.7
Revenue per Hour of Patient Care	\$201.4	\$236.1	\$237.7	\$244.2
Revenue per Hour Excl. Uninsured	\$232.1	\$263.9	\$257.5	\$256.3

Notes: 'Estimated Weekly Revenue Generated' is computed by multiplying weekly privately-insured patient visits by reported average prices using responses to the question: 'On average, what is your net fee after discount for an initial office visit with a private, commercially-insured patient?', plus Medicaid patient visits multiplied state average primary care reimbursement rates from Zuckerman et al (2009), plus Medicare patient visits times the geographic reimbursement rate for CPT code 99214. 'Revenue per Hour Excl. Uninsured' adjusts the number of hours of patient care by the fraction of patients who are uninsured, from whom reimbursement is unknown.

Both higher patient levels and more favorable patient mixes contribute to employed physicians with NCAs generating 35% more revenue per week (\$8,964 vs. \$6,637). With

[24] It is difficult to draw conclusions based on the number of uninsured patients, some of whom may be treated as charity or below-cost care, while others may pay out-of-pocket.

[25] Medicare rates are based on service code 99214, corresponding to an office visit by an established patient. Medicaid rates are state average primary care rates from Zuckerman et al. (2009).

only about 11% more hours worked per week, this translates to 17% more revenue per hour of patient care.[26]

More revealing are the differences between firms that use NCAs and those that do not in the disparities in the allocation of clients between owners and workers. In firms that use NCAs, employed physicians generate about $8,964 in revenue per week while owners generate about $9,246. In firms that do not use NCAs, however, the difference is substantially larger and statistically significant—employed physicians generate about $6,637 per week, compared to $8,253 for owners. This difference in disparities is consistent with greater intra-firm referrals, as predicted by our model.

Still, the exact mechanism behind these patterns is unclear. Clearly, patient mixes can affect the incentive to use NCAs, and firms with the largest potential benefit from NCAs are most likely to impose them. However it is also possible that firms using NCAs have more valuable patients *because* they have successfully prevented workers from poaching valuable clients in the past.

In Appendix Table A6 we look for evidence that the difference in revenue generate by physicians with NCAs is due to selection based on the types of workers or firms that choose to use NCAs. We find that the difference in revenue associated with NCAs cannot be explained by physician and practice characteristics; in fact, conditioning on observable characteristics increases the estimated revenue disparities associated with NCAs. The table also shows that these patterns hold within geographic markets.

This evidence on patient allocations is of course not causal, but it is consistent with the first prediction from our model. Along with the additional results on returns to tenure, earnings effects, and compensation structures, the combination of evidence is broadly consistent with all three predictions from the model, in which NCAs are used by physicians to prevent poaching and protect the value of patient stocks.

5.3 Do Physician Practices Use NCAs to Reduce Turnover and Hiring Costs?

It is also possible that physician practices use NCAs to reduce turnover and hiring costs. If so, we are interested in estimating the relative importance of these different sources of benefits in affecting firms' decisions to use NCAs.

There are several mechanisms through which NCAs could increase the length of job spells. They could deter exit directly by making it more costly, they could induce self-selection by workers with private knowledge about their expectation for remaining at the firm, or they could reduce the probability that an outside offer will exceed earnings by increasing the returns to tenure. While it is not possible to identify each of these effects separately with available data, we are able to estimate the overall relationship between NCA

[26] We use the term 'productivity' for brevity to denote the ratio of revenue generated per hour, but do not mean to imply that the social value of the services provided by physicians with NCAs is higher.

use and the duration of job spells.

Previous studies in the literature have shown that NCAs have causal effects on worker job mobility rates. Marx et al. (2009) use an exogenous inadvertent change in enforcement of NCAs in Michigan in 1985 and find that the average mobility of inventors producing patents in Michigan fell relative to the mobility of inventors in other states as a result of the increase in the enforceability of NCAs. Marx (2011) finds 40% of electrical engineers surveyed had signed NCAs, and that workers who left firms were more likely to switch industries if they were subject to an NCA.

Table 10: Unconditional Comparison of Job Tenure and Experience

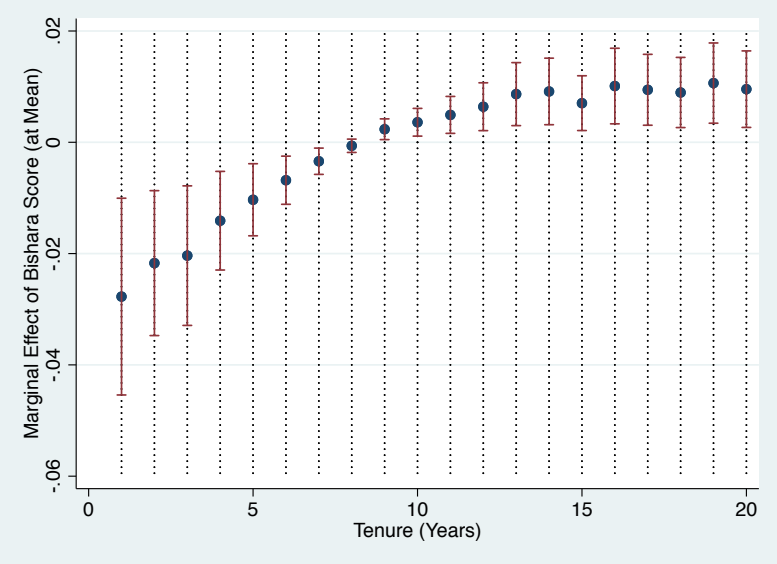
	Job Tenure		Experience	
	Without NCA	With NCA	Without NCA	With NCA
1 to 7 Years	61.70%	50.49%	26.75%	30.10%
8 to 14 Years	27.96%	33.98%	32.22%	30.42%
15 to 21 Years	8.51%	12.94%	30.70%	31.72%
22+ Years	1.82%	2.59%	10.33%	7.77%
P-Value of Chi-Square Test	0.032		0.572	

Notes: Values are percentages of physicians in sample with tenure or experience within the corresponding range of years. Sample includes employed physicians who are neither partners nor sole owners of the practices at which they work, and who graduated from medical school since 1980.

Table 10 shows the unconditional distribution of job tenures for physicians with and without NCAs. As expected, physicians with NCAs are significantly less likely to have begun their job within the prior seven years. Figure 3 shows similar patterns conditional on observed characteristics. The figure plots the estimated difference in the conditional probability of observing a given year of tenure for a physician with an NCA relative to one without. Physicians with NCAs were significantly less likely to have tenures between one and seven years, and significantly more likely to have tenure of nine or more years. These patterns imply that the CDF of job tenures of physicians with NCAs first-order stochastically dominates the distribution for those without NCAs.

Table 11 presents our main estimates on job spell durations from fixed effects negative binomial models of job tenure, conditional on observed worker and firm characteristics and primary care market effects. Column 1 shows physicians with NCAs have 12.3% longer job spells. Column 2 shows that the difference in job spell lengths increases to 29.6% when using variation in state enforceability. Although these are not causal effects, there is some suggestive evidence on the mechanism behind these patterns that is consistent with NCAs causally lengthening job spells. Since firms are more likely to use NCAs where they are more enforceable, this suggests that if the entire difference in job tenures were due to sorting on unobserved preferences for mobility, then as enforceability increases the marginal workers who accept NCAs should be more likely to switch jobs. Column 2 suggests

Figure 3: Marginal Effects of NCA on Years of Tenure



Notes: Graph shows the effects of a one unit increase in 'Bishara Score*NCA' on the conditional probability of observing a given year of tenure based on estimates from an ordered probit model with covariates identical to Model 1 in Table 11. 95% confidence intervals shown in bars.

the opposite—where enforceability is higher job spells are longer.

Column 3 adds the 'Bishara Score' without interacting with NCA use. The coefficient reveals information about sorting on unobservables. For workers without NCAs, who should not be directly affected by state enforceability laws, higher enforceability is actually associated with shorter job spells. This suggests that physicians sort into jobs based on preferences for mobility. In combination, the three models provide suggestive evidence that each of the potential mechanisms we discuss appears to play some role in increasing the length of job spells. However, with only a single cross-sectional sample, a direct relationship between tenure and job-spell length requires a stationarity assumption in the difference between the rates of job flows for jobs with and without NCAs (Kiefer et al., 1985).

Although these increases in job-spell length may be valuable to firms, are the reductions in hiring costs large enough to explain the estimated difference in career earnings? To answer this question, we calculate the net present value of the earnings differences associated with using NCAs as a function of the length of completed job spells by integrating over the discounted difference between the two functions in the bottom of Figure 1 from zero to year T. We then back out the hiring costs that firms would have to face in order to be indifferent about paying the present value of the wage differential to achieve these reductions in turnover. The estimates of course require assumptions about workers' time preferences for money. At the mean completed job-spell length of 14 years, the present value of the future wage differential associated with NCAs is between $149,000–$274,000 when the rate

Table 11: Negative Binomial Fixed Effects Models of Job Tenure

	(1)		(2)		(3)	
	IRR	SE	IRR	SE	IRR	SE
NCA	1.123 **	[0.056]				
Bishara Score*NCA			1.296 ***	[0.108]	1.207 ***	[0.068]
Bishara Score					0.831 ***	[0.049]
Office-Based	1.114	[0.079]	1.107	[0.078]	1.205 ***	[0.069]
Free-Standing Practice	1.087	[0.222]	1.077	[0.218]	0.842	[0.149]
University Practice	1.132	[0.117]	1.144	[0.118]	1.297 ***	[0.101]
Multi-Specialty Practice	0.944	[0.048]	0.941	[0.048]	0.941 *	[0.032]
Small Practice	0.860 **	[0.053]	0.856 **	[0.053]	0.902 **	[0.037]
Part Owner	1.322 ***	[0.070]	1.340 ***	[0.071]	1.271 ***	[0.042]
Internal Medicine	0.984	[0.067]	0.978	[0.066]	0.925 *	[0.041]
Pediatrics	1.021	[0.061]	1.011	[0.061]	0.982	[0.036]
Secondary Specialty	1.018	[0.059]	1.005	[0.058]	0.961	[0.040]
Male	1.052	[0.053]	1.052	[0.053]	1.032	[0.035]
US Med. School	1.336 ***	[0.099]	1.332 ***	[0.098]	1.383 ***	[0.074]
Experience	1.061 ***	[0.004]	1.062 ***	[0.004]	1.068 ***	[0.003]
Log Likelihood	−1208.96		−1206.91		−2502.44	
N	650		650		892	

Notes: Dependent variable is number of years of tenure at current job for physicians who completed medical school since 1980. Incidence-rate ratios (IRR) reported. Models 1 and 2 include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care, Model 3 controls for state NCA enforceability, and all models include race indicators, county-level unemployment and uninsurance rates. Sample excludes sole owners, and includes primary care markets with at least two observations. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

of time preference varies between 10% and 2%. The largest estimate of the effect of NCAs on job-spell lengths is a 29.6% increase, which implies that the cost of hiring one primary care physician would have to be at least \$653,000–\$1,200,000 to justify paying workers this earnings differential solely to reduce turnover. Appendix Figure A1 plots the full range of estimates as a function of tenure, and shows sensitivity of the estimates to the assumed discount rate. For the full range of discount rates the average implied threshold hiring costs are implausibly high for primary care physicians, suggesting that although turnover reductions appear to be substantial, they are very unlikely to be the primary motivation behind the use of NCAs among physician practices.

This conclusion may of course be specific to physicians or other skilled service workers, in part because the nature of job mobility is somewhat different. In other markets where markets are defined by products rather than by geography, NCAs can have very different types of mobility effects since workers may have to switch industries to avoid violating the contract. Fallick et al. (2006) and Gilson (1999) discuss the strong importance of job mobility on the formation of agglomeration economies in technology-producing markets like Silicon Valley, and suggest that the lack of enforceability of NCAs contributed to the microfoundations of agglomeration economies in the technology sector.

5.4 Robustness Analyses

5.4.1 Selection on Quality

Although our main analyses in Section 5.2.1 include a test for potential correlation between NCA use (or enforceability) and unobserved firm characteristics that impact the rate of earnings growth, another possibility is that the unobserved characteristics of individual physicians are correlated with NCA use. Of course, if such a correlation occurred systematically among individual physicians, it would generate a firm-level correlation (Abowd et al. 1999), which is contrary to the empirical evidence. Still, our survey data contain a variety of rich direct and indirect measures of quality, which are also useful in assessing how plausible this concern may be. First, we observe negotiated prices between private commercial insurance plans and physician practices, which may capture differences in average practice quality. We find that there is substantial variation in negotiated prices for a standard primary care office visit, even within geographic markets. For example, using Dartmouth PCSA as a market definition, we estimate the within-market standard deviation in negotiated prices to be $35.49. This suggests that characteristics of physician services are reflected in prices. However, we find no significant difference in unconditional average prices associated with a practice's use of NCAs ($91.14 [SE $2.90] with NCAs and $89.14 [SE $2.29] without).

Appendix Table A1 presents estimated conditional price differences from fixed effects models that regress negotiated prices on observed physician and practice characteristics, with geographic market effects based on county or PCSAs. Each of the models suggests that prices vary with physician characteristics as expected. For example, physicians with two or more specialties receive on average $25 to $31 more per visit than family practice or general physicians. We find no significant difference in prices charged by physicians based on the use of NCAs. The difference in conditional mean prices is also very small, between $1 to $2. This suggests that any potential difference in quality between physicians with NCAs does not appear to be captured by market prices.

Second, we compare data that directly tests the clinical knowledge of physicians in our sample. The survey included a series of hypothetical clinical situations followed by questions about the diagnoses and recommended treatments for the patients described in the scenarios. The vignettes and questions were designed by clinical consultants and pretested with a clinical panel to ensure that they provide meaningful and accurate assessments of physician practice patterns. Similar vignette-based surveys have been used extensively in the medical literature to measure variations in the approaches to diagnoses and treatment recommendations among physicians, and have been convincingly shown to provide measures of quality of care that are even more reliable than data from medical records (Veloski et al., 2005). Since some of the questions are subjective, we first test whether there are any differences in the patterns of responses of physicians with and without NCAs using a chi-

square test, without evaluating whether the responses comply clinical guidelines. Of the 62 chi-square tests for differences in responses to each question, there was only one question to which physicians with NCAs responded significantly differently (at the 5% level) than physicians without NCAs.[27]

For one vignette based on the diagnosis and treatment of Asthma, we also compare responses to clinical guidelines and calculate an aggregate measure of compliance for each physician.[28] Compliance with Asthma guidelines was tested specifically because it provides a relatively objective assessment of clinical knowledge. We find no statistically significant difference in overall compliance with clinical guidelines associated with the use of NCAs. There was, however, considerable potential for measuring variation, as slightly fewer than half of physicians in the survey gave responses in compliance with clinical guidelines.

Third, we test whether physicians with NCAs had more experience prior to beginning their current job, since experience tends to be strongly correlated with patient perceptions of quality (Choudrhy et al., 2005). Table 12 reports marginal effects from a probit model that regresses NCA use on experience prior to the beginning of a physician's current job, along with physician, practice, and market characteristics. We find that experience in prior jobs has precisely no effect on the probability of having an NCA.

Collectively, this evidence suggests that systematic differences in physician quality based on the use of NCAs are very unlikely, and cannot be detected in a variety of rich quality measures used frequently in the medical literature.

5.4.2 Can These Patterns Be Explained By Deferred Compensation Contracts?

Another potential alternative explanation for these earnings patterns is that they are simply due to differences in deferred compensation. For example, Lazear (1979) shows that deferred compensation contracts, in which young workers earn less than their marginal value product and older workers recoup the deficits from when they were younger, may be preferred by both firms and workers as a mechanism for preventing shirking. This type of contract may also reduce turnover. By increasing the attachment of a worker to a particular firm, deferred compensation contracts could be substitutes for NCA contracts. If this were true, we might expect that NCAs eliminate the need for deferred compensation, allowing firms to pay workers their spot marginal value product, while physicians without NCAs receive the deferred compensation contract.

However, there are several pieces of evidence that are contrary to this potential explanation. First, the earnings profiles suggest that physicians with NCAs earn higher hourly earnings throughout the first 30 years of tenure, which is more than twice the length of

[27] See Appendix Figure A2 for the full distribution of p-values.

[28] We construct a measure of compliance based on Asthma guidelines developed by NIH Heart, Lung and Blood Institute and the American Academy of Pediatrics. We define Asthma Guideline Compliance in the vignette as a correct diagnosis of persistent moderate asthma, treatment prescription of inhaled corticosteroids year-round, and recommending a follow-up visit with one month.

Table 12: Probit Model: Are Firms that Use NCAs More Likely to Hire Physicians with More Prior Experience?

	Coef.		SE
Prior Experience	0.00		[0.00]
Internal Medicine	0.03		[0.03]
Pediatrics	0.06	**	[0.03]
Secondary Specialty	−0.01		[0.03]
Planning to Retire Soon	−0.24	***	[0.04]
Office-Based	−0.06	*	[0.04]
Free-Standing Practice	−0.26	***	[0.04]
University Practice	−0.15	***	[0.05]
Large Practice (25+)	0.05		[0.03]
Multi-Specialty Practice	0.17	***	[0.03]
Part Owner	0.12	***	[0.03]
Independent Contractor	−0.02		[0.06]
% Patients Uninsured	0.00		[0.00]
US Med. School	0.12	***	[0.03]
N	1533		

Notes: Marginal effects at sample means reported. Model also includes race indicators, geographic practice cost index, log physicians per capita in county, a cubic in county population, county household median income, unemployment rate, and poverty rate, and state effects. Standard errors in brackets are heteroskedasticity-adjusted. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

the average completed job spell in the sample. As a result, there is virtually no period in the career profile in which workers without NCAs appear to recoup earnings in excess of those of physicians with NCAs. Moreover, the differences in earnings appear to be commensurate with differences in revenue generated and patient visits, suggesting that NCAs have effects on the marginal value product of labor, and not simply on the relative timing of compensation. Finally, if the entire difference in earnings profiles were due to the use of deferred compensation contracts among physicians without NCAs, the evidence from comparing turnover rates to earnings levels implies that the amount of compensation that would have to be deferred would exceed hundreds of thousands of dollars, which may lead to much lower turnover rates for physicians with high levels of tenure and no NCA contracts. We do not observe any such pattern in the data.

5.4.3 Correlation with Other State Policies

Finally, we assess whether estimates based on Bishara Scores could potentially be confounded by other correlated state laws. For example, ideologies of voters about the role of state governments or workers' rights may affect a broad array of state policies that are correlated with NCA laws.

The extent to which this may be a concern is limited for several reasons. As common law, the enforceability of NCAs in states has evolved through precedent over hundreds of

years, and the majority of this precedent was established under English or French law, long before most of the legislation that shapes US state policies currently (Bishara, 2011). US states differ in both the strength of influence and geography of origin of their civil law traditions, for reasons that are unrelated to current voters' ideologies. Employment NCA laws in California, for example, have not changed materially since 1872, before health insurance or modern healthcare markets existed.

We show empirical evidence that the enforceability of NCA laws is on average uncorrelated with the modern-era political preferences of states. Appendix Figure A3 plots Bishara scores versus vote shares for major-party US presidential candidates from 1992-2008. We find that there is no evidence of any systematic relationship between voter preferences and state NCA policies.

Hausman and Lavetti (2017) test for correlations between changes in NCA laws and a broader array of political and economic outcomes, as well as cultural views using the Generalized Social Survey (GSS). They find that NCA law changes are uncorrelated with unemployment rates, population levels, political preferences, views about the size of government, and many other outcomes.

6 Discussion

Nearly every state permits the use of NCAs, and about 37% of the entire workforce in the US has signed an NCA,[29] but the economic rationales behind their use in some employment settings are not always transparent. Using new data from a survey of primary care physicians, we document that NCAs are used very frequently among physicians. A unique feature of our survey is that it combines direct information about contract structures leading to incentive pay, individual measures of productivity, as well as variation in human resource management practices, including NCAs (Bloom and Van Reenen, 2010). This breadth of information allows for a comprehensive view of the mechanisms behind firms' incentives to use NCAs, allowing us to empirically assess the relative importance of each of the potential sources of benefits.

We show a wide range of evidence consistent with the hypothesis that physician practices use NCAs to prevent their patients from being poached. Our most robust findings come from longitudinal earnings models showing that NCAs substantially increase the rate of return to tenure, which we show is a predicted outcome if firms use NCAs to convert patient relationships into firm-specific human capital. Estimates from this model allow for the possibility that jobs with NCAs may be unobservably different, and that unobserved firm characteristics, such as managerial ability, may be correlated with the rate of earnings growth and with the use of NCAs. In addition to this primary evidence, we show a range of suggestive evidence using survey data that collectively helps to corroborate this hypothesis.

[29] See US Department of the Treasury Report, 2016.

We find much lower disparities in the allocation of patients between practice owners and employed physicians in firms using NCAs, suggesting practices that use NCAs are more likely to share patients, for example through intra-firm referrals. We also show that the earnings of physicians who sign NCAs are more strongly tied to individual output, as opposed to fixed salaries, consistent with theoretical predictions. Whereas one concern about the use of NCAs is that they could harm workers, these patterns suggest that bundling NCAs with incentive-based compensation contracts can overcome the impacts of reducing workers' bargaining power.

We also find evidence that jobs requiring NCAs tend to last longer, suggesting that there are some benefits associated with reductions in turnover. However, we back out a threshold hiring cost of about $0.65 to $1.20 million dollars per hire that would be required to justify the estimated earnings differentials if the only source of benefits were from turnover reductions. This implausibly high hiring cost for a primary care physician (more than three times larger than annual earnings) suggests that, although there appear to be meaningful reductions in turnover, the benefits are secondary relative to those associated with reducing poaching.

Our estimates can assist policymakers in evaluating the effects of NCAs and shaping public policy. Several states have changed their laws to expressly prohibit the use of NCAs by physicians,[30] and President Obama urged states to completely ban NCAs for most workers,[31] despite a dearth of empirical evidence on the effects of NCAs. We also draw attention to an important policy-relevant distinction between the use of NCAs by high skilled service firms to control relationship-assets and by technology firms that use NCAs to protect intellectual property. Whereas evidence, such as that in Fallick et al (2006), has suggested that the absence of enforceable NCAs may have contributed to the microfoundations of local agglomeration economies, we find that the presence of enforceable NCAs increases earnings growth and investment among service firms. Consistent with this notion, some states have very recently passed laws disentangling NCA policies across job sectors. For example, Hawaii banned the use of NCAs among technology workers, while New Mexico and several other states have banned NCAs specifically for healthcare workers.

Although our new survey data provide the first comprehensive information on the use of NCAs in physician practices, or in skilled service firms more generally, one limitation is that the survey data do allow us to conduct analyses using longitudinal variation in NCA policies. Our primary approach is to present a pattern of coherent evidence that is consistent with reasonable theoretical predictions, and to directly test potential threats to identification. This relatively understudied topic could benefit greatly from additional analyses that make

[30] In 2008, Massachusetts legislators banned the use of NCAs for physicians and nurses, citing issues with their effects on medical professionals' rights to practice and patients' rights to choose practitioners. In Tennessee, in 2005 the Supreme Court banned the use of NCAs for physicians under Murfreesboro Medical Clinic, PA v. Udom, 166 S.W.3d 674 (Tenn. 2005).

[31] See Reuters News, October 25, 2016 "White House Urges Ban on Non-Compete Agreements for Many Workers," available at http://www.reuters.com/article/us-usa-noncompetes-idUSKCN12P2YP

use of exogenous law changes, and combine more comprehensive evidence on firms, workers, and consumers to assess the welfare effects of NCA policies more broadly.

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Appendix: For Online Publication

Table A1: Fixed Effects Models: Prices Charged by Practices that Use NCAs

	(1)		(2)		(3)	
	β	SE	β	SE	β	SE
NCA	-1.70	[4.52]	1.89	[8.24]		
Bishara Score*NCA					1.75	[11.77]
Office-Based	13.24	[10.61]	3.68	[20.16]	3.61	[20.20]
Free-Standing Practice	-7.46	[14.65]	-29.24	[25.69]	-29.33	[25.70]
University Practice	47.73	[38.09]	41.58	[57.59]	41.94	[57.06]
Large Practice (25+)	-5.14	[5.60]	-6.43	[11.05]	-6.39	[11.08]
Multi-Specialty Practice	0.74	[5.35]	4.68	[9.64]	4.90	[9.53]
Part Owner	-8.49*	[4.58]	-9.12	[7.73]	-8.95	[7.75]
Independent Contractor	6.16	[12.51]	-3.83	[15.29]	-3.63	[15.40]
Internal Medicine	10.30*	[6.14]	7.53	[11.39]	7.49	[11.39]
Pediatrics	-2.39	[4.77]	-4.88	[8.10]	-4.94	[8.03]
Secondary Specialty	26.17***	[6.37]	31.33***	[9.87]	31.26***	[9.88]
US Med. School	15.10***	[5.56]	17.59*	[9.09]	17.53*	[9.10]
Male	-2.04	[4.69]	-2.96	[7.98]	-3.04	[7.99]
Job Tenure	-0.50	[0.36]	-0.84	[0.64]	-0.84	[0.64]
Experience	0.09	[0.38]	0.42	[0.65]	0.41	[0.65]
County Effects	Yes		No		No	
Primary Care Market Effects	No		Yes		Yes	
R Sq.	0.34		0.60		0.60	
N	659		659		659	

Notes: Dependent variable is the reimbursement rate for privately-insured patient. The survey question was worded: 'On average, what is your net fee after discount for an initial office visit with a private, commercially-insured patient?' Model 1 includes county effects, and Models 2 and 3 include Primary Care Service Area (PCSA) market effects from the Dartmouth Atlas of Health Care. PCSAs market definitions are calculated based on patient travel patterns for primary care services. All models also include race indicators. Standard errors in brackets are heteroskedasticity-adjusted. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Table A2: Bishara (2011) Rating of the Restrictiveness of Non-Compete Agreements

Question #	Question	Criteria	Question Weight
Q1	Is there a state statute that governs the enforceability of covenants not to compete?	10 = Yes, favors strong enforcement 5 = Yes or no, in either case neutral on enforcement 0 = Yes, statute that disfavors enforcement	10
Q2	What is an employer's protectable interest and how is that defined?	10 = Broadly defined protectable interest 5 = Balanced approach to protectable interest 0 = Strictly defined, limiting the protectable interest of the employer	10
Q3	What must the plaintiff be able to show to prove the existence of an enforceable covenant not to compete?	10 = Weak burden of proof on plaintiff (employer) 5 = Balanced burden of proof on plaintiff 0 = Strong burden of proof on plaintiff	5
Q3a	Does the signing of a covenant not to compete at the inception of the employment relationship provide sufficient consideration to support the covenant?	10 = Yes, start of employment always sufficient to support any CNC 5 = Sometimes sufficient to support CNC 0 = Never sufficient as consideration to support CNC	5
Q3b	Will a change in the terms and conditions of employment provide sufficient consideration to support a covenant not to compete entered into after the employment relationship has begun?	10 = Continued employment always sufficient to support any CNC 5 = Only change in terms sufficient to support CNC 0 = Neither continued employment nor change in terms sufficient to support CNC	5
Q3c	Will continued employment provide sufficient consideration to support a covenant not to compete entered into after the employment relationship has begun?	10 = Continued employment always sufficient to support any CNC 5 = Only change in terms sufficient to support CNC 0 = Neither continued employment nor change in terms sufficient to support CNC	5
Q4	If the restrictions in the covenant not to compete are unenforceable because they are overbroad, are the courts permitted to modify the covenant to make the restrictions more narrow and to make the covenant enforceable? If so, under what circumstances will the courts allow reduction and what form of reduction will the courts permit?	10 = Judicial modification allowed, broad circumstances and restrictions to maximum enforcement allowed 5 = Blue pencil allowed, balanced circumstances and restrictions to middle ground of allowed enforcement 0 = Blue pencil or modification not allowed	10
Q8	If the employer terminates the employment relationship, is the covenant enforceable?	10 = Enforceable if employer terminates 5 = Enforceable in some circumstances 0 = Not enforceable if employer terminates	10

Source: Bishara (2011).

Table A3: Bishara (2011) Summary of State Restrictiveness of Non-Compete Agreements

	California	Georgia	Illinois	Pennsylvania	Texas
Average Total Score	31	285	430	365	350
State Rank*	50	43	4	23	32
Q1	10	30	50	50	80
Q2	10	70	70	70	80
Q3	5	25	30	20	35
Q3(a)	0	50	50	50	20
Q3(b&c)	0	50	50	25	15
Q4	0	0	90	80	60
Q8	0	60	90	70	60

Note: *Out of 51, including D.C.. 1 is the most restrictive.
Source: Bishara (2011). See Table A2 for explanation of question numbers.

Table A4: Fixed Effects Models of Aggregate Physician Supply

Dependent Variable:	Log Physicians per 100,000 Population	
Bishara Score	-0.055	
	(0.036)	
Lagged Bishara Score	0.012	0.030
	(0.041)	(0.028)
Log Per Capita Income	0.149*	0.149*
	(0.030)	(0.030)
N	48,881	48,881
Adj. R Sq.	0.87	0.87

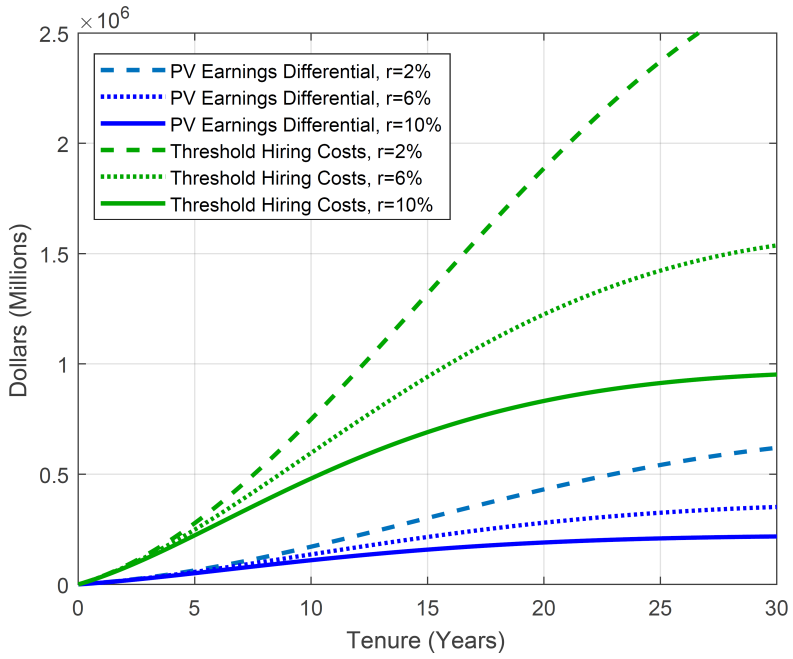
Notes: All specifications are fixed effects models and include county effects and year effects. Robust standard errors reported. Number of physicians per county measured using CMS MPIER file from 1996-2007. Bishara Scores measured in every state year from 1996-2007 using data from Hausman and Lavetti (2016). * indicates significance at the 0.05 level.

Table A5: Fixed Effects Wage Models

	(1) Dep Var: Log Hourly Earnings		(2) Dep Var: Log Hourly Earnings		(3) Dep Var: Log Annual Earnings	
	β	SE	β	SE	β	SE
NCA	0.125 **	[0.061]	1.059 ***	[0.407]	−1.309 **	[0.593]
NCA*Log Exp.			−0.389 **	[0.151]	1.346 ***	[0.507]
Bishara Score*NCA			−1.377 **	[0.533]		
Bishara Score*NCA*Log Exp			0.587 ***	[0.198]		
NCA*Log Exp. Sq.					−0.289 ***	[0.106]
Office-Based	−0.128	[0.078]	−0.139 *	[0.079]	−0.135 *	[0.078]
Free-Standing Practice	−0.151	[0.227]	−0.170	[0.230]	−0.147	[0.230]
University Practice	0.111	[0.159]	0.087	[0.157]	0.099	[0.154]
Multi-Specialty Practice	0.029	[0.063]	0.030	[0.063]	0.032	[0.062]
Small Practice (1-3)	0.012	[0.066]	0.021	[0.065]	0.018	[0.065]
Part Owner	0.086	[0.062]	0.079	[0.061]	0.095	[0.062]
Sole Owner	−0.112	[0.097]	−0.122	[0.097]	−0.131	[0.097]
Independent Contractor	−0.036	[0.156]	−0.059	[0.152]	−0.055	[0.154]
Patients per Week	0.001 **	[0.001]	0.001 *	[0.001]	0.001 **	[0.001]
Internal Medicine	0.055	[0.080]	0.045	[0.080]	0.062	[0.080]
Pediatrics	0.054	[0.071]	0.043	[0.071]	0.050	[0.071]
Secondary Specialty	0.054	[0.081]	0.040	[0.082]	0.041	[0.082]
Male	0.115 *	[0.068]	0.117 *	[0.067]	0.129 *	[0.066]
US Med. School	−0.041	[0.102]	−0.037	[0.102]	−0.036	[0.102]
Log Tenure	0.242 *	[0.140]	0.234 *	[0.139]	0.257 *	[0.140]
Log Tenure Sq.	−0.042	[0.037]	−0.038	[0.037]	−0.048	[0.037]
Log Exp.	0.210	[0.231]	0.199	[0.255]	−0.674	[0.462]
Log Exp. Sq	−0.047	[0.052]	−0.041	[0.054]	0.133	[0.097]
R Sq.	0.508		0.519		0.516	
N	894		894		894	

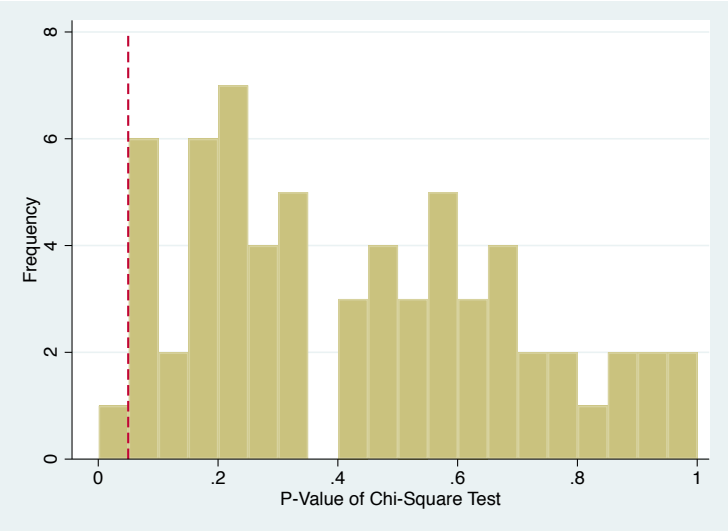
Notes: All models include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. White-Huber standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$

Figure A1: Is Preventing Turnover the Primary Explanation for NCA Use?



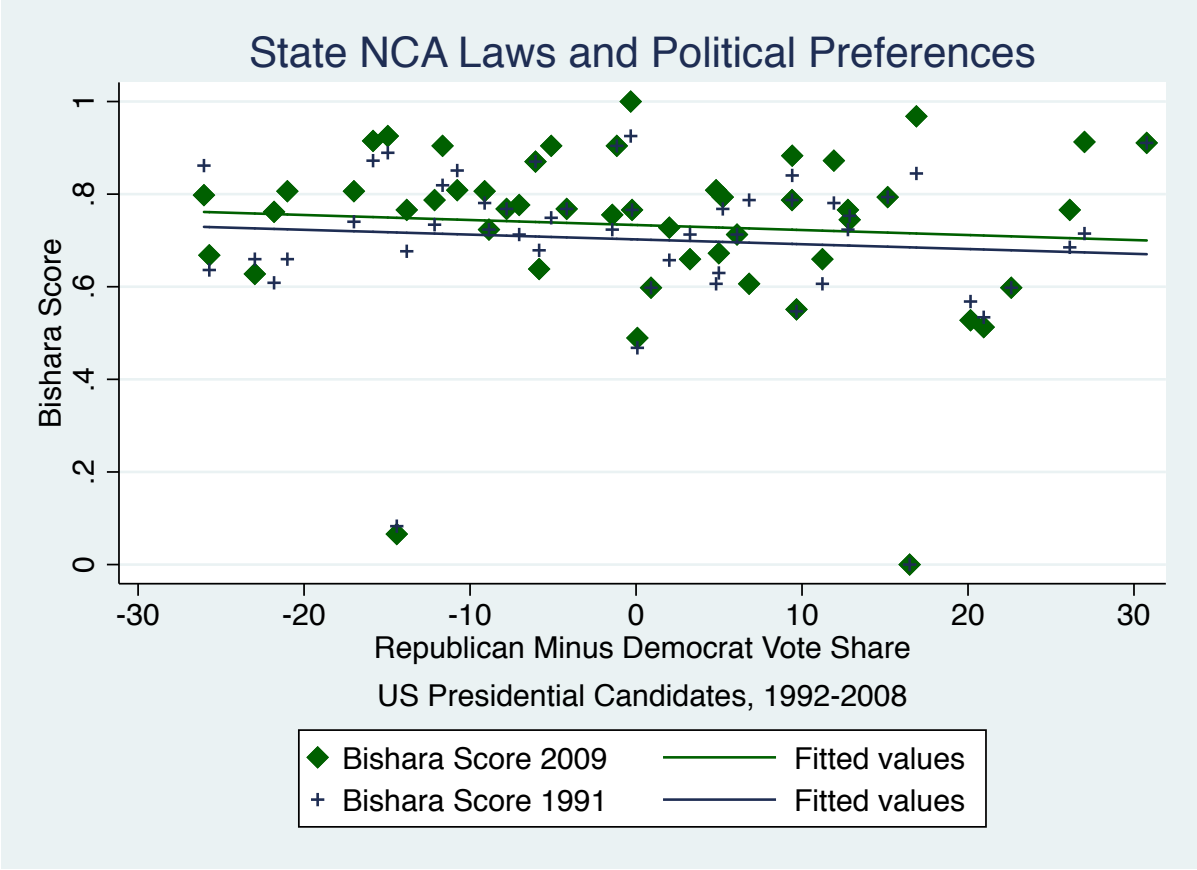
Notes: 'Present Value of Earnings Differential' calculated by integrating over the difference in the predicted wage-tenure profiles shown in Figure 1, discounted at the corresponding interest rates shown. 'Threshold Hiring Costs' are the minimum costs to the firm of recruiting one additional worker that are implied by the wage and job-spell length differences associated with NCA use, if job turnover were the only explanation why firms use NCAs. The calculations come from the 'PV of Earnings Differentials' combined with the job-spell duration effects predicted by Model 2 in Table 11.

Figure A2: Tests of Differences in Responses to Clinical Questions: Comparison of Physicians With and Without NCAs



Notes: Graph is a histogram of the p-values of chi-square tests of the null hypothesis that physicians with NCAs gave the same responses to the corresponding vignette question as physicians without NCAs. Samples include physicians with 15 of fewer years of experience. The vertical red line corresponds to cutoff of p-values below 0.05. Vignette questions were designed by clinical consultants and pre-tested with a clinical panel. See Appendix 6.3 for additional details.

Figure A3: State NCA Laws and Political Preferences



Notes: Data points are Bishara Scores normalized such that the highest value, Florida in 2009, equals 1. The horizontal axis measures the difference between the percentage of voters in the corresponding state that voted for the Republican Party presidential candidate minus the share that voted for the Democrat Party candidate, averaged over the five elections between 1992 and 2008. 'Fitted Values' shows the predicted equation from an OLS regression of the Bishara Score on vote shares. The slope coefficient is -0.059 with a standard error of 0.097 in 1991, and -0.061 with a standard error of 0.106 in 2009.

Table A6: NCAs and Conditional Revenue Generated
Dependent Variable: Revenue Generated per Hour

	Coef.	SE
NCA	79.75	[60.15]
Owner	30.66	[44.37]
Owner*NCA	-41.37	[66.75]
Internal Medicine	-23.82	[39.96]
Pediatrics	21.27	[34.29]
Secondary Specialty	49.27	[36.59]
Office-Based	21.60	[75.54]
Free-Standing Practice	-1.69	[101.94]
University Practice	-67.54	[125.97]
Multi-Specialty Practice	-3.72	[31.28]
Independent Contractor	-134.33	[107.60]
Potential Experience	-10.98	[7.39]
Potential Experience Sq.	0.24	[0.18]
Job Tenure	7.32	[6.63]
Job Tenure Sq.	-0.23	[0.21]
Male	-8.52	[35.63]
US Med. School	-74.50**	[35.83]
R Sq.	0.71	
N	473	

Notes: Dependent variable is revenue per hour of patient care. Revenue is calculated by multiplying the number of weekly privately-insured patient visits by the reported average prices based on responses to the question: 'On average, what is your net fee after discount for an initial office visit with a private, commercially-insured patient?', plus the number of patient-visits covered by Medicaid multiplied by a state-level index of reimbursement rates for a standard bundle of primary care services based on data from Zuckerman et al (2009), plus the number of patient-visits covered by Medicare times the reimbursement rate in the relevant geographic area for CPT code 99214. Model 1 is OLS, Model 2 is a fixed effects model with Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. White-Huber standard errors in brackets. * $p < 0.10$, ** $p < 0.05$.

Table A7: Can Altruism Explain Variation in Compensation Contracts?

Dep Var:	Share of Earnings from Individual Production				
	Employed Physicians			Part-Owners	
NCA	0.185***	0.182***	0.161*	0.030	-0.075
	[0.039]	[0.047]	[0.091]	[0.047]	[0.091]
Percent Charity Main Practice		-0.222	-0.485	0.191	-1.931
		[0.170]	[0.319]	[0.809]	[1.283]
Any Charity Outside Practice		-0.003	0.209	-0.125	-0.068
		[0.060]	[0.155]	[0.096]	[0.175]
Hours of Charity Outside Practice		-0.004**	-0.008*	0.006	0.006
		[0.002]	[0.004]	[0.011]	[0.019]
Control Variables:	No	Yes	Yes	Yes	Yes
State Effects:	Yes	Yes	No	Yes	No
PCSA Effects:	No	No	Yes	No	Yes
R Sq.	0.047	0.180	0.746	0.152	0.738
N	459	375	375	325	325

Notes: Dependent variable is the share of earnings that are based directly on a physician's individual productivity. Column 1 is a univariate regression without any controls. Columns 2 through 5 also include controls for specialty, practice setting, practice size, employed spouse, US medical school graduate, experience, experience squared, gender, county median household income, and county population. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. White-Huber standard errors in brackets. $*p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

NCA Use Conditional on Selection into Group Practice

To show heterogeneity in the characteristics of practices that choose to impose NCAs, it may also be informative to consider the joint decision whether to join a group practice, since NCAs are only used in group practices. We model the pair of decisions using a bivariate probit model to account for sample selection. The selection equation for entering a group practice or hospital is a probit model:

$$g_i = z_i\gamma + u_i$$

where g_i equals 1 if physician i chooses a group practice and 0 if they choose a solo practice, and z_i is a vector of physician and market characteristics, and the decision to accept an NCA as:

$$N_i = x_i\beta + \varepsilon_i$$

where N_i equals 1 if physician i accepts an NCA and x_i contains observable characteristics of the group practice, the geographic market, and physician i. The reason for estimating the equations simultaneously is that u_i may be correlated with ε_i. For example, latent preferences for geographic mobility could affect both the decision to start a solo practice and the costs associated with accepting an NCA.

The selection equation is fully observed in that we have complete information for the entire sample, but the NCA equation exhibits incidental truncation since we do not know whether physicians in solo practices would have accepted NCAs if they had instead chosen to work in a group practice. The log-likelihood function is:

$$\begin{aligned}\log L &= \sum_{i=1}^{N}\{g_i N_i \ln\Phi_2(z_i\gamma, x_i\beta;\rho) + g_i(1-N_i)\ln[\Phi_1(x_i\beta) - \Phi_2(z_i\gamma, x_i\beta;\rho)] \\ &+ (1-g_i)\ln\Phi_1(-x_i\beta)\}\end{aligned}$$

where Φ_1 is the distribution of ε_i and Φ_2 is the bivariate normal distribution of (ε_i, u_i). Identification comes primarily from two exclusion restrictions. The selection equation includes a geographic index of the overhead costs associated with operating a physician practice, which is excluded from the NCA equation. This index affects the incentive to share overhead costs across a group. The NCA model includes characteristics of the group practice, which are excluded from the selection equation.

Table A8 presents estimates of the marginal effects of observed characteristics on the probability of accepting an NCA, conditional on selection into a group practice. To be clear, these estimates are intended only as stylized summary statistics that describe patterns of NCA usage, while accounting for correlation with the decision to enter a group practice. We find that physician, practice, and market characteristics are strongly predictive of NCA use. Estimates in column 1 suggest that physicians in office-based practices are about 18 percentage points more likely to have NCAs, while those in free-standing clinics and university practices are about 22 and 18 percentage points less likely, respectively. Part owners are also about 12 percentage points less likely to have NCAs. Physicians who are likely to be less mobile for observable reasons, such as having an employed spouse, are also less likely to be bound by NCAs.

In column 3 we include the Bishara Score and find that it is strongly predictive—an

Table A8: Bivariate Probit Model with Sample Selection: Determinants of NCA Usage

Dependent Variable: Non-Compete Agreement

	(1)		(2)		(3)	
	$(dy/dx\|s=1)$	SE	$(dy/dx\|s=1)$	SE	$(dy/dx\|s=1)$	SE
Bishara Score					0.322***	[0.069]
Office-Based	0.180***	[0.037]	0.185***	[0.037]	0.179***	[0.037]
Free-Standing Practice	-0.214*	[0.123]	-0.200	[0.127]	-0.213*	[0.122]
University Practice	-0.187***	[0.058]	-0.185***	[0.058]	-0.183***	[0.058]
Multi-Specialty Practice	0.038	[0.036]	0.035	[0.035]	0.040	[0.035]
Large Practice (25 Plus)	0.021	[0.042]	0.013	[0.042]	0.018	[0.042]
Part Owner	-0.122***	[0.032]	-0.164*	[0.090]	-0.122***	[0.032]
Independent Contractor	-0.208***	[0.053]	-0.198***	[0.054]	-0.208***	[0.053]
Internal Medicine	0.052	[0.040]	0.057	[0.040]	0.054	[0.040]
Pediatrics	0.056	[0.035]	0.055	[0.035]	0.060*	[0.035]
Secondary Specialty	0.059	[0.038]	0.056	[0.038]	0.064*	[0.038]
Plan to Retire	-0.218**	[0.087]	-0.203**	[0.091]	-0.223***	[0.085]
Male	0.006	[0.033]	0.007	[0.033]	0.006	[0.033]
Employed Spouse	-0.072**	[0.031]	-0.071**	[0.031]	-0.072**	[0.031]
US Med. School	0.046	[0.046]	0.049	[0.046]	0.053	[0.045]
Median HH Income	0.029	[0.178]	0.096	[0.180]	0.021	[0.171]
Poverty Rate	-0.004	[0.011]	-0.003	[0.011]	-0.005	[0.010]
Unemployment Rate	-0.052**	[0.026]	-0.049*	[0.025]	-0.056**	[0.026]
State PA	0.115	[0.091]	0.117	[0.108]		
State CA	-0.182***	[0.071]	-0.251***	[0.082]		
State TX	0.038	[0.074]	0.082	[0.091]		
State IL	0.093	[0.081]	0.070	[0.099]		
Log Potential Experience	-0.015	[0.009]	-0.016*	[0.009]	-0.014	[0.009]
Log Potential Experience Sq.	0.001*	[0.000]	0.001*	[0.000]	0.001*	[0.000]
Adult Uninsured Rate	-0.005	[0.006]	-0.006	[0.006]	-0.007*	[0.004]
% Employed in Agriculture	0.014*	[0.008]	0.014*	[0.008]	0.014*	[0.008]
% Employed in Construction	0.027	[0.016]	0.028*	[0.016]	0.029*	[0.015]
% White Collar Jobs	-0.004	[0.005]	-0.003	[0.005]	-0.004	[0.005]
State PA*Part Owner			-0.052	[0.119]		
State CA*Part Owner			0.186	[0.119]		
State TX*Part Owner			-0.065	[0.109]		
State IL*Part Owner			0.067	[0.130]		
Log Likelihood	-1596.41		-1590.71		-1604.95	
Log Likelihood under Null of No Selection Bias	-1601.49		-1594.79		-1607.53	
p-value of LR Test	0.001		0.004		0.023	
N	1677		1677		1677	

Notes: Marginal effects at means reported conditional on selection into a group practice. Selection model, not shown, includes a geographic physician practice cost index (GPCI), and its squared value. GPCI is calculated by the US GAO to estimate geographic variation in the cost of operating a private medical practice to set Medicare reimbursement rates. The group practice equations exclude GPCI, and include group practice characteristics, which are excluded from the selection equations. All models also include cubic function of county population, and physician race. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

increase in enforceability from the least restrictive state (ND) to the most restrictive state (FL) is associated with a 30 percentage point increase in the probability that a physician will have an NCA. This suggests that firms consider state laws to be important factors in

calculating the expected benefits to imposing NCAs. It is still possible that some firms use unenforceable NCAs simply as threats. This may explain why about 30% of employed physicians in CA have NCAs despite their lack of enforceability in the state. Selection into NCAs also appears to be related to the decision whether to start a solo practice or join a group practice. The p-values of an LR test of no selection, shown in Table A8, range from 0.01 to 0.09 in the three models shown.

Model Appendix

Our goals in this section are (1) to articulate an example of a theoretical model in which physician practices value NCAs because they prevent patients from being poached, (2) to use the predictions from the model to motivate the intuition behind our empirical analyses.

The model is simplified to include only necessary features for motivating our analyses, and abstracts from potentially interesting extensions such as the structure of firms or the role of physical capital. However, the model does incorporate important legal constraints discussed above in Section 2.3 by prohibiting compensation contracts that may potentially be interpreted as including an implicit or explicit purchase or sale of patient referrals. Without these features, which may be unique to medical professionals, the model could be adapted to generate different predictions in alternative settings.

6.1 Basic Model Setup

We consider a two-period model of a firm owned by a physician proprietor, indexed by a, who is endowed with P patients, which she can treat to generate revenue

$$Y = f(P)$$

where f is assumed to satisfy: $f(0) = 0$, $f'(P) > 0$, and $f''(P) < 0$. The strictly concave production function f can be interpreted as the monetary equivalent of the utility the owner would receive by treating the patients, net of any utility lost to providing the effort and time required to treat the patients.

Alternatively, the owner could hire a worker physician, indexed by w. In this case, the owner can choose to allocate ("refer") $P_w \equiv P - P_a$ patients to the worker, and the firm's per-period profit is given by:

$$\pi = f(P_a) + f(P_w) - S$$

where S is the cost of paying the worker's salary. Since f is strictly concave, it is potentially advantageous for the owner to share the patients with the worker and pay the worker's salary. However, any allocated patients P_w become loyal to the worker physician, who may then poach the patients.

The worker may exit the firm in the second period for two reasons. First, with probability $(1-\rho)$ the employment relationship exogenously becomes unproductive and the worker and firm separate, where $0 < \rho < 1$. Second, if the worker can earn a higher salary in the outside competitive market she will voluntarily exit, taking any allocated patients with her. The outside option salary for a physician without any patients is denoted $\bar{S}$, and the outside option increases to $f(P_w)$ for a worker with P_w loyal patients.

In order to prevent the worker from poaching patients in the second period, the owner may require the worker to agree to an NCA. If a worker signs an NCA and the job is then terminated for any reason, allocated patients are returned to the owner, and the worker must exit the geographic market. At the beginning of period 1, workers have heterogeneous geographic location preferences R_w, expressed in monetary units, which are distributed uniformly $R_w \sim U[0, \bar{R}]$, and are private knowledge of the worker. Larger R_w indicate high willingness to pay for staying in the geographic market, which increases the expected cost of signing an NCA. At the end of period 1, workers receive geographic preference shocks with a discrete uniform distribution $\varepsilon \sim \{-e, e\}$, where $e = \frac{\bar{R}}{2}$. Therefore the sum $(R_w + \varepsilon) \sim U[-e, \bar{R} + e]$ is a continuous uniform distribution. If $R_w + \varepsilon$ is sufficiently

negative, relative to earnings potential, workers may increase their utility by moving to a new geographic market.

The timing of events occurs as follows. At time zero, firms post take it or leave it offers that have three elements: (1) non-compete agreements $\{N, C\}$, where N corresponds to a contract with an NCA, and C to a contract without, (2) first-period compensation, S_1, and (3) second-period compensation, S_2. Workers observe all posted offers and choose jobs that maximize earnings $S_1 + S_2$, net of any expected relocation costs $\mathbb{E}[R_w]$.[32] Firm owners then make patient referral choices. Production occurs, workers and firms earn payoffs, and then exogenous separation draws ρ are realized. Workers then announce whether they wish to voluntarily exit the job.

Contractual commitments to allocate P_w are forbidden, and as discussed in Section 2.3, compensation in each period must be based on fair market value and may not include an implicit purchase or sale of patient referrals. We impose this legal constraint by assuming a minimum salary $S \geq \bar{S}$ in each period, which is consistent with fair market value and prevents workers from forgoing salary to implicitly purchase referrals.[33]

We begin the model by considering fixed salary compensation only, and allowing one-sided forward commitments by the firm to guarantee S_2. We then consider an extension of the model in which future salary commitments have limited credibility—firms can guarantee not to cut earnings, but they may not credibly commit to guarateed salary increases. These assumptions about contract structures play an important role, because once a worker has signed an NCA their reservation salary decreases in the second period due to the cost of relocating.

Firms maximize the sum of expected profits over the two periods $\pi_1 + \pi_2$. Workers choose jobs that maximize two-period earnings net of expected relocation costs, $S_1 + S_2 - \mathbb{E}[R_w]$.

Hedonic wage theory (Rosen, 1974) says that the competitive market salary will be determined by the preferences of the marginal worker, who has a value of $R^\star$ that makes them indifferent to accepting an NCA. Since we are interested in studying a mixed equilibrium, in which some jobs include NCAs and others do not, we assume that $\bar{R}$ is sufficiently large that some workers would never accept an NCA at any price that firms are willing to pay. The hedonic equilibrium is therefore characterized by a single worker with preferences $R^\star$ that determines assignment to jobs: workers with $R_w < R^\star$ sort into jobs with NCAs, and workers with $R_w > R^\star$ sort into jobs without NCAs. For simplicity, we also assume that $R^\star > e$, which implies that workers who sort into jobs without NCAs will never choose to relocate (as long as their earnings do not decrease in period two.)

Earnings Path and Patient Referrals Without NCAs

If a contract does not include an NCA, the firm owner maximizes profits by solving:

$$\max_{P_a} 2f(P_a) + (1+\rho)f(P_w) - S_1 - \rho S_2$$

where $P_a = P - P_w$. The worker will accept the offer as long as $S_1 + S_2 \geq 2\bar{S}$.

Working backwards, in the second period the firm must offer the worker at least the

[32] Note that when choosing jobs, workers do not require compensation for the risk that their preferences will change in the future, leading them to voluntarily exit the job. However, firms do consider this possibility when maximizing profits.

[33] We are grateful to an anonymous referee for noting that removing this model assumption may lead to alternative model predictions.

outside option salary, $S_2 \geq f(P_w)$, to prevent the worker from voluntarily exiting. This second period constraint captures the idea that once a worker controls patients P_w they bring more value to an outside firm, increasing output above the level that could be produced by a worker without patients, $\bar{S}$. Knowing this, the firm would ideally like to offer the bundle $\{S_1, S_2\}$ at which the two-period participation constraint is binding, which implies $S_1 = 2\bar{S} - S_2 = 2\bar{S} - f(P_w)$. However, this contract requires the worker to implicitly pay the agent for the value of referrals, $f(P_w)$, which the worker then recoups in the second period. In practice this contract would be illegal because physicians are prohibited from receiving explicit or implicit compensation for referrals. This prohibition on both overt and covert markets for patient referrals is fundamentally why NCAs can create value in this setting, offering protection against losing valuable assets for which there is no market.

To model this legal constraint, we assume the agent must offer the fair market salary, without accounting for the value of referrals: $S_1 \geq \bar{S}$. Given this legal restriction, the initial participation constraint $S_1 + S_2 \geq 2\bar{S}$ cannot bind with equality. When both the retention constraint and legal constraint bind: $S_1 = \bar{S}$ and $S_2 = f(P_w)$. The firm's problem is then:

$$\max_{P_a} 2f(P_a) + f(P_w) - \bar{S}$$

The FOC is

$$\frac{\partial \pi}{\partial P_a} = 2f'(P_a) + f'(P_w)\frac{\partial P_w}{\partial P_a} = 0$$

$$\Rightarrow \quad f'(P_a^{C\star}) = \frac{f'(P_w^{C\star})}{2}$$

Earnings Path and Patient Referrals With NCAs

Contracts that include NCAs are more complicated, because the probability of separation may depend on earnings. The unconditional probability of separation is given by:

$$\mathbb{P}[sep] = (1-\rho) + \rho\mathbb{P}\left[R_w + \varepsilon < \bar{S} - S_2\right]$$

$$\mathbb{P}[sep] = (1-\rho) + \rho\left[\frac{\bar{S} - S_2 + e}{\bar{R} + 2e}\right]$$

Note that

$$\frac{\partial \mathbb{P}[sep]}{\partial S_2} = \frac{-\rho}{\bar{R} + 2e} < 0$$

The firm's profit maximization problem is:

$$\max_{P_a, S_1, S_2} (2 - \mathbb{P}[sep])\left[f(P_a^N) + f(P_w^N)\right] + \mathbb{P}[sep]f(P) - S_1 - (1 - \mathbb{P}[sep])S_2$$

When firms use NCAs there are no externalities between factors of production, patients and labor. When the firm hires a worker, the firm's referral decision is independent of wages that offered to recruit the worker. Therefore we can first solve the patient referral problem, and then solve the profit maximizing salary offers.

Patient referrals are chosen by solving:

$$\max_{P_a} (2 - \mathbb{P}[sep])\left[f(P_a^N) + f(P_w^N)\right] + \mathbb{P}[sep]f(P) - S_1 - (1 - \mathbb{P}[sep])S_2$$

The FOC is:

$$\frac{\partial \pi}{\partial P_a} = (2 - \mathbb{P}[sep]) \left[f'(P_a^N) + f'(P_w^N) \frac{\partial P_w^N}{\partial P_a^N} \right] = 0$$

$$\Rightarrow \quad f'(P_a^{N\star}) = f'(P_w^{N\star}) \quad \Rightarrow \quad P_a^{N\star} = P_w^{N\star} = \frac{P}{2}$$

This solution, along with the concavity of f, gives the first hypothesis of the model:

Hypothesis 1 *Physicians with NCAs will have more patients allocated to them by the practice owner:* $P_w^{N\star} > P_w^{C\star}$.

Notice that since NCAs allow firms to equitably distribute patients, the total output is greater even though all firms use the same inputs.

Corollary 1 *The more equitable distribution of clients made possible by NCAs increases the productive efficiency of firms.*

Given this solution to the referral problem, firms choose salary offers by maximizing

$$\max_{S_1, S_2} (2 - \mathbb{P}[sep]) 2f(P/2) + \mathbb{P}[sep] f(P) - S_1 - (1 - \mathbb{P}[sep]) S_2$$

Plugging in the formula for the probability of separation gives:

$$\max_{S_1, S_2} 4f(P/2) - \left[(1-\rho) + \rho \left[\frac{\bar{S} - S_2 + e}{\bar{R} + 2e} \right] \right] [2f(P/2) - f(P) - S_2] - S_1 - S_2$$

subject to the legal constraint on minimum salaries, and the worker's participation constraint:

$$S_1, S_2 \geq \bar{S}$$

$$S_1 + \rho S_2 + (1-\rho)(\bar{S} - R^\star) \geq \bar{S} + f(P_w^{C\star})$$

Notice that the worker's participation constraint is based on ρ, the probability they are forced to separate. Firms do not compensate workers for the risk that the worker's geographic preferences may change, leading the worker to prefer to relocate in the future. The Kuhn-Tucker conditions are:

$$\lambda_1(\bar{S} - S_1) = 0$$

$$\lambda_2(\bar{S} - S_2) = 0$$

$$\lambda_3 \left[\bar{S} + f(P_w^{C\star}) - S_1 - \rho S_2 - (1-\rho)(\bar{S} - R^\star) \right] = 0$$

$$\lambda_1, \ \lambda_2, \ \lambda_3 \geq 0$$

The FOCs with respect to S_1 and S_2, respectively, are

$$-1 + \lambda_1 + \lambda_3 = 0 \quad \Rightarrow \quad \lambda_1 + \lambda_3 = 1 \tag{9}$$

$$\frac{\rho}{\bar{R} + 2e} \left[2f(P/2) - f(P) + \bar{S} - 2S_2 + e \right] - \rho + \lambda_2 + \rho\lambda_3 = 0 \tag{10}$$

Case 1: Suppose $\lambda_2 > 0$
Complementary slackness implies $S_2 = \bar{S}$, along with the recruiting constraint implies $S_1 > \bar{S}$, which implies $\lambda_1 = 0$. (9) implies $\lambda_3 = 1$, so the complementary slackness condition

implies

$$\bar{S} + f(P_w^{C\star}) - S_1 - \rho\bar{S} - (1-\rho)(\bar{S} - R^\star) = 0$$

$$S_1 = f(P_w^{C\star}) + (1-\rho)(R^\star)$$

Plugging S_1 into (10) implies:

$$\frac{\rho}{\bar{R} + 2e}\left[2f(P/2) - f(P) - \bar{S} + e\right] + \lambda_2 = 0$$

This is a contradiction, because $2f(P/2) - f(P) - \bar{S}$ is the increase in profit that a firm earns by hiring a worker with an NCA and paying the minimum salary $\bar{S}$. This sum must be positive in order for any hiring to occur in the model. Since the sum of the first three terms is positive, the magnitude of the shock $e > 0$, and $\lambda_2 \geq 0$ by the Kuhn-Tucker conditions, (10) cannot possibly hold in this case.

Case 2: Suppose $\lambda_2 = 0$, $\lambda_1 > 0$, and $\lambda_3 = 0$
Complementary slackness implies $S_1 = \bar{S}$ and the recruiting constraint implies $S_2 > \bar{S}$.
(10) implies

$$\frac{\rho}{\bar{R} + 2e}\left[2f(P/2) - f(P) + \bar{S} - 2S_2 + e\right] = \rho$$

$$2f(P/2) - f(P) + \bar{S} + e = \bar{R} + 2e + 2S_2$$

$$S_2 = \frac{2f(P/2) - f(P) + \bar{S} - \bar{R} - e}{2}$$

The restriction $S_2 > \bar{S}$ holds if

$$\frac{2f(P/2) - f(P) + \bar{S} - \bar{R} - e}{2} > \bar{S}$$

$$2f(P/2) - f(P) > \bar{S} + \bar{R} + e$$

This condition says that the increase in per-period revenue from equally distributing patients over two workers is larger than the sum of $\bar{S}$ plus the largest possible willingness to pay to remain in the geographic market. If this condition held, then the firm would be willing to pay $R^\star$ even if $R^\star = \bar{R}$, so every firm would use NCAs. Since our primary interest in the model is a mixed equilibrium, we assume that $\bar{R}$ is large enough that some workers would never accept an NCA at any price that firms would be willing to pay. Under this assumption, the restriction required for $S_2 > \bar{S}$ to hold cannot be satisfied.

Case 3: Suppose $\lambda_2 = 0$, $\lambda_1 > 0$, and $\lambda_3 > 0$
$\lambda_1 > 0$ implies $S_1 = \bar{S}$ and the recruiting constraint implies $S_2 > \bar{S}$.
Complementary slackness implies S_2 solves:

$$\bar{S} + f(P_w^{C\star}) - \bar{S} - \rho S_2 - (1-\rho)(\bar{S} - R^\star) = 0$$

$$\Rightarrow S_2 = \frac{f(P_w^{C\star}) - (1-\rho)(\bar{S} - R^\star)}{\rho}$$

Notice that S_2 in this case is always strictly greater than $\bar{S}$ because

$$\frac{f(P_w^{C\star}) - (1-\rho)(\bar{S} - R^\star)}{\rho} > \bar{S}$$

$$\Rightarrow f(P_w^{C\star}) + (1-\rho)R^\star > \bar{S}$$

which always holds because $f(P_w^{C\star}) > \bar{S}$.
(9) implies:

$$\lambda_3 = 1 - \lambda_1 > 0 \Rightarrow 0 < \lambda_3 < 1$$

(10) implies:

$$\frac{\rho}{\bar{R}+2e}\left[2f(P/2) - f(P) + \bar{S} - 2S_2 + e\right] - \rho + \rho\lambda_3 = 0$$

$$\frac{\rho}{\bar{R}+2e}\left[2f(P/2) - f(P) + \bar{S} - 2S_2 + e\right] = \rho(1-\lambda_3) = \rho\lambda_1$$

$$\lambda_1(\bar{R}+2e) = 2f(P/2) - f(P) + \bar{S} - 2S_2 + e$$

$$\lambda_1 = \frac{2f(P/2) - f(P) + \bar{S} - 2S_2 + e}{\bar{R}+2e}$$

Notice that the RHS is a probability, consistent with the restriction that $0 < \lambda_1 < 1$.

$$\lambda_1 = \mathbb{P}\left[R_w + \varepsilon < 2f(P/2) - f(P) - S_2 + (\bar{S} - S_2)\right]$$

This is equal to the probability that a worker would prefer to voluntarily exit in period 2 if they are offered a salary equal to the firm's entire second period profit, $2f(P/2) - f(P) - S_2$ less $\bar{S} - S_2 < 0$, which is the opportunity cost in lost wages of voluntarily moving. This, along with (9), implies:

$$\lambda_3 = \mathbb{P}\left[R_w + \varepsilon \geq 2f(P/2) - f(P) - S_2 + (\bar{S} - S_2)\right]$$

which has a similar interpretation as the probability of deterring a worker from having a preference for exiting.

The equilibrium earnings path in jobs with NCAs is therefore $\{S_1^N, S_2^N\} = \{\bar{S}, \frac{f(P_w^{C\star}) - (1-\rho)(\bar{S}-R^\star)}{\rho}\}$.

Hypothesis 2 *Physicians with NCAs have greater within-job earnings growth, and the earnings growth is due to larger returns to tenure, conditional on experience.*

Statement: "Physicians with NCAs have greater within-job earnings growth":
Proof: All physicians earn $\bar{S}$ in period 1. In period 2, $S_2^C = f(P_w^{C\star})$, while

$$S_2^N = \frac{f(P_w^{C\star}) - (1-\rho)(\bar{S} - R^\star)}{\rho} > f(P_w^{C\star})$$

To see why this last inequality is true, notice that $f(P_w^{C\star}) = \rho S_2^N + (1-\rho)(\bar{S} - R^\star)$ is a ρ-weighted average of S_2^N and $\bar{S} - R^\star$. Since $f(P_w^{C\star}) > \bar{S} - R^\star$, $f(P_w^{C\star})$ can only be a weighted average if $S_2^N > f(P_w^{C\star})$.
Statement: "the earnings growth is due to larger returns to tenure, conditional on experience":
Proof: Total earnings growth is the sum of returns to experience and returns to tenure. For physicians without NCAs, $S_2^C = f(P_w^{C\star})$ regardless of whether the worker remains at the firm or separates in period 2. Therefore, for workers without NCAs, earnings are equal when job tenure is zero or one, so the return to job tenure conditional on experience is zero. The return to experience is $S_2^C - S_1^C = f(P_w^{C\star}) - \bar{S} > 0$.

For physicians with NCAs, if a separation occurs in period 2, then earnings in the second period are $\bar{S}$. Therefore physicians without NCAs receive zero earnings growth when moving

from experience-tenure pair $(0,0)$ to $(1,0)$, so the return to experience conditional on tenure is zero. For physicians that remain at the same firm, earnings growth when moving from experience-tenure pair $(0,0)$ to $(1,1)$ is $S_2^N - S_1^N > 0$. This earnings growth is the sum of the experience component, $(1,0)-(0,0)$ and the tenure component, $(0,1)-(0,0)$. The former is zero, so all of the earnings growth is due to larger returns to tenure, conditional on experience.

6.2 Contracting Frictions, Bargaining, and Earnings

A stylized fact of labor markets, however, is that forward commitments to guaranteed salary increases are rarely observed. If firms cannot credibly commit to a contract specifying a second-period salary, then NCAs create a bargaining problem. Once a worker has signed an NCA their bargaining position decreases in the second period, since the firm knows that the worker's reservation wage has declined due to the cost of relocating. Without credible forward commitments, workers may demand front-loaded compensation in order to accept a job with an NCA. All else equal, this incentive may force the earnings path to be flatter than the profit-maximizing path derived above. Flattening the earnings path increases the probability of worker separations in the second period, and reduces welfare relative to the equilibrium with credible forward commitments.

Our goal in this section to demonstrate that there exists an incentive compatible revenue-sharing contract in which the loss of ex post bargaining position due to NCAs does not cause distortions that flatten earnings paths, avoiding potential deadweight loss from excess turnover. The existence of such a contract suggests that when turnover is costly to firms, as is the case in the model presented above, then share-based contracts may be Pareto-improving relative to front-loaded or flat compensation paths.

To see this, suppose compensation structures may depend linearly on output:

$$M = S + \alpha f(P_w)$$

where α is the share of output that the worker keeps as compensation. A contract is now defined as (1) first-period compensation, M_1, (2) non-compete agreements $\{N, C\}$, and (3) forward "sticky wage" commitments by the firm to not reduce S or α in the second period. The sticky wage commitment reflects the limited credibility of guaranteed future salary increases, but allows firms to credibly commit to not decreasing either compensation parameter.[34]

To pin down the intuition behind the model equilibrium, suppose there is a small amount of stochasticity in output. We also introduce an upward-sloping output function, by assuming that output grows in the second period at the rate $\delta > 1$. Firms without NCAs have no compelling reason to use revenue-sharing contracts. Since the firm is risk-neutral, they will insure the worker against output shocks by offering the contract $\{S_C^1, \alpha_C^1\} = \{\bar{S}, 0\}$ in period 1. The worker can then re-negotiate the contract in the second period by threatening to separate, $\{S_C^2, \alpha_C^2\} = \{\delta f(P_w), 0\}$.

Workers with NCAs, however, cannot increase their compensation in the second period by threatening to exit, since the worker's expected outside option yields a payoff of only

[34] One reason why such a contract may occur is if workers choose effort, and firms are hesitant to commit to second period salary increases due to moral hazard. Facing uncertain effort, firms may be willing to commit to forward share-based contracts even when they would not commit to forward salary levels. For example, with Cobb-Douglas production and variable capital inputs, firms will pay labor a fixed share of output that is independent of effort.

$\bar{S} - \mathbb{E}[R_w]$. Anticipating that their bargaining position will decline in the second period, workers must negotiate an ex ante incentive-compatible contract with fixed compensation components $\{S_N, \alpha_N\}$.

To gain intuition, suppose for simplicity that output shocks are very small, so the profit-maximizing equilibrium earnings path can be approximated by re-solving the model with log utility:

$$\max_{S_1,S_2}(2+\delta)f(P/2) - \left[(1-\rho) + \rho\left[\frac{\bar{S} - S_2 + e}{\bar{R} + 2e}\right]\right][2\delta f(P/2) - \delta f(P) - S_2] - S_1 - S_2$$

subject to the legal constraint on minimum salaries, and the worker's participation constraint:

$$S_1, S_2 \geq \bar{S}$$

$$\rho \ln(S_1 + S_2) + (1-\rho)\ln(S_1 + \bar{S} - R^\star) \geq \ln(\bar{S} + \delta f(P_w^{C^\star}))$$

When $S_1 = \bar{S}$ and the recruiting constraint binds,

$$(\bar{S} + S_2)^\rho + (2\bar{S} - R^\star)^{(1-\rho)} = \bar{S} + \delta f(P_w^{C^\star})$$

$$S_2 = \frac{\left(\bar{S} + \delta f(P_w^{C^\star})\right)^{1/\rho}}{(2\bar{S} - R^\star)^{\frac{(1-\rho)}{\rho}}} - \bar{S}$$

The profit maximizing earnings path is

$$\{S_1, S_2\} = \left\{\bar{S}, \frac{\left(\bar{S} + \delta f(P_w^{C^\star})\right)^{1/\rho}}{(2\bar{S} - R^\star)^{\frac{(1-\rho)}{\rho}}} - \bar{S}\right\}$$

Now, introducing revenue-sharing contracts, the equilibrium compensation contract $\{S_N, \alpha_N\}$ that matches this profit-maximizing earnings profile must satisfy:

$$S_N + \alpha_N f(P/2) = \bar{S} \tag{11}$$

$$S_N + \alpha_N \delta f(P/2) = \frac{\left(\bar{S} + \delta f(P_w^{C^\star})\right)^{1/\rho}}{(2\bar{S} - R^\star)^{\frac{(1-\rho)}{\rho}}} - \bar{S} \tag{12}$$

Equation (11) implies $\alpha_N = \frac{\bar{S} - S_N}{f(P/2)}$. Subtracting (11) from (12) gives:

$$\alpha_N(\delta - 1)f(P/2) = \frac{\left(\bar{S} + \delta f(P_w^{C^\star})\right)^{1/\rho}}{(2\bar{S} - R^\star)^{\frac{(1-\rho)}{\rho}}} - 2\bar{S} > 0$$

Notice that the RHS is strictly positive, because of the earnings constraint $S_2 > \bar{S}$ implies:

$$\frac{\left(\bar{S} + \delta f(P_w^{C^\star})\right)^{1/\rho}}{(2\bar{S} - R^\star)^{\frac{(1-\rho)}{\rho}}} > 2\bar{S}$$

The LHS is also strictly positive since $\delta > 1$. This implies $\alpha_N > 0$.

The economic intuition behind this result is straightforward. Although limited credi-

bility constrains the set of contracts, this constraint can be overcome if the firm uses fixed revenue-sharing rates to match the profit-maximizing earnings path that would occur under perfect forward credibility. This equilibrium requires the existence of an upward-sloping function to which α can be tied; growing output, $\delta > 1$, is one natural example of such a function. When this occurs, firms can bundle NCAs with revenue-sharing contracts, which allows compensation to increase along with output, without the need to renegotiate contract terms in the second period.

Hypothesis 3 *If long-term forward compensation contracts have limited credibility, and output grows over time, then firms that use NCAs can use share-based compensation contracts in which $\alpha_N^\star > \alpha_C^\star$ to achieve the same profit-maximizing earnings path that would occur under credible forward contracts.*

In this simple model we abstract from explaining which firms choose to use NCAs, and the hedonic equilibrium is driven entirely by sorting on worker preferences. Of course, in a more realistic setting the decision by a firm to impose NCAs is unlikely to be random. For example, firms in geographic markets with fewer patients per physician (lower endowments of P per firm) may derive more benefits from protecting the marginal patient from being poached, increasing $R^\star$, and hence the fraction of employees with NCAs. Similarly, if production is augmented by a persistent productivity shifter $\tau f(P)$, more productive firms may derive greater benefits from NCAs. Finally, if firms differ in hiring costs, higher cost firms may benefit more from NCAs. Although our theoretical discussion abstracts from many of these issues, appropriate interpretation of our empirical estimates depends on the extent to which potentially unobserved factors directly affect both the decision to use NCAs as well as the outcomes of interest in our hypotheses. We return to discuss these selection issues, and the conditions under which our parameter interpretations may be affected by selection, in Section 5.

6.3 Summary of Testable Hypotheses

The goal of our empirical analyses is to test for evidence that physician practices use NCAs to prevent patients from being poaching, protecting firms' investments in client relationships, which we model as intra-firm referral choices in the stylized model above. Our primary analyses test Hypothesis 2, that NCAs increase the rate of return to job-tenure. We test this hypothesis by estimating the relationship between the use of NCAs and within-job earnings growth, and decomposing the earnings growth differential into components due to experience and job tenure.

We also make use of several other predictions from the model to provide corroborating suggestive evidence. Hypothesis 1 is that firms that use NCAs allocate more patients to employed physicians. In the survey data, we are able to observe the distribution of patients to physicians. We test for evidence of disparities in the allocation of patients between employed physicians and those that have equity ownership in the firm. If NCAs reduce referral holdups, firms that use NCAs should have more balanced distributions of patient loads across physicians. In the medical context, however, all patients are not alike. Physicians that treat privately insured patients tend to receive higher reimbursements than than those that treat Medicaid patients, for example. In addition to testing for overall disparities in the number of clients, we also examine heterogeneity in the allocation of clients by their source of insurance coverage.

Hypothesis 3 is that NCAs may be bundled with share-based compensation incentives to overcome the effects of changes in bargaining position. We use data on the fraction of earnings that come from incentive payments tied to individual production to provide stylized summary statistics on this hypothesis. We also empirically evaluate the alternative hypothesis that physician practices use NCAs solely to reduce job turnover.

PHYSICIAN PERSPECTIVES ON PATIENT CARE SURVEY

Boston University Medical Center

AGENCY FOR HEALTHCARE RESEARCH AND QUALITY

The California Endowment

THE COMMONWEALTH FUND

Section 1: Physician and Practice Characteristics

The questions in this section collect background information about you and your practice.

Q1 1. What is your primary specialty? **(CHECK ONE BOX)**

1 ☐ Family or General Practice
2 ☐ Internal Medicine
3 ☐ Pediatrics
4 ☐ Other (Please specify): _____

Q2 2. Do you have a secondary specialty or subspecialty?

1 ☐ Yes (Please specify): _____
2 ☐ No

Q3 3. Have you changed your primary specialty since you began practicing?

1 ☐ Yes → 3a. What was your prior specialty? Q3a → not included (text)
2 ☐ No

Q4 4. Do you expect to continue providing patient care for the next 3 years?

1 ☐ Yes, I plan to continue providing patient care
2 ☐ No, I expect to retire
3 ☐ No, I expect to leave patient care for other employment

Q5 5. Do you have admitting privileges at a tertiary care hospital?

1 ☐ Yes
2 ☐ No

Q6 6. Do you work in more than one medical practice?

1 ☐ Yes → 6a. How many? Q6A
99999 where Q6≠1
2 ☐ No

Please answer the following items about your main medical practice, which is the practice where you spend most of your time.

Q7 7. What type of practice is this? **(CHECK ONE BOX)**

1 ☐ Office-based practice
2 ☐ Hospital-based practice
3 ☐ Free-standing care center
4 ☐ University or academic medical center-based practice
5 ☐ Community health center
6 ☐ Other type of organization

Q8 8. In what zip code is this medical practice located? _____

Q9 9. What year did you begin working in this practice? _____

Q10 10. Including you, how many physicians work in this practice?

_____ physicians **(IF YOU ARE A SOLO PRACTITIONER, SKIP TO QUESTION 14)**

Q11 11. How many physicians were in this practice 3 years ago?

_____ physicians or ☐ Don't Know 7777 → 3 Q11DKREF
☐ Practice did not exist 3 years ago. 8888
99999 - where Q10 = 1

Q12 12. How many physicians work full time?

_____ physicians or ☐ Don't Know 7777 → Q12DKREF
9999 where Q10=1

Q13 13. Is this a single-specialty or multi-specialty practice?

1 ☐ Single-specialty
2 ☐ Multi-specialty
99999 where Q10=1

Q14 14. Are you a sole owner of your practice, part-owner, employee or independent contractor?

1 ☐ Sole owner **(SKIP TO QUESTION 19)**
2 ☐ Part owner
3 ☐ Employee
4 ☐ Independent contractor

Q15 15. How many physicians in this practice are owners, including yourself? _____
99999 where Q14=1,.

Q16 16. Do you participate in decisions that affect which managed care contracts your practice signs?

1 ☐ Yes
2 ☐ No
99999 where Q14=1,.

Q17 17. Do you have input into decisions affecting the size of the practice?

1 ☐ Yes
2 ☐ No
99999 where Q14=1,.

Q18 18. Were you to leave your (main) practice, would you be subject to a non-compete clause?

1 ☐ Yes
2 ☐ No
99999 where Q14=1,.

Q19 19. Are you accepting new patients into your practice?

only Q19=2 has to answer Q19A & B

1 ☐ Yes, all new patients
2 ☐ Yes, some new patients → 19a. Are you accepting new **Medicare** patients? Q19A
1 ☐ Yes
2 ☐ No
19b. Are you accepting new **Medicaid** patients? Q19B
1 ☐ Yes
2 ☐ No
3 ☐ No

We would like to ask you some questions about your activities during a typical week in your practice.

Q20 20. How many hours do you work in your main medical practice in a typical week? Include patient care and non-patient care hours.

_____ hours or ☐ Don't Know

77777 where DK=1

Q21 21. How many hours do you spend on patient care-related activities?
(EXCLUDE TIME ON CALL)

_____ hours or ☐ Don't Know

77777 where DK=1

22. What percent of this time is spent delivering care related to your main medical specialty?

_____ % or ☐ Don't Know

77777 where DK=1

23. In a typical week, what percentage of the time do you work with a nurse practitioner or physician's assistant? **(ENTER 0 IF NONE)**

_____ %

Q24 24. How many patients do you see in a typical week?

_____ patients

25. In a typical week, what percentage of your patients in your main practice are ...

	%	Compared to the other physicians in my practice this percentage is **(CHECK ONE BOX ON EACH LINE)** 1 Higher	2 Lower	3 About the same
(a) Latino or Hispanic?	Q25A_1	Q25B_1 ☐	☐	☐
(b) Black or African American? (non-Hispanic)	Q25A_2	Q25B_2 ☐	☐	☐
(c) Limited in English proficiency?	A_3	B_3 ☐	☐	☐
(d) Insured by Medicaid?	-4	B_4 ☐	☐	☐
(e) Insured by Medicare?	-5	B_5 ☐	☐	☐
(f) Uninsured?	-6	B_6 ☐	☐	☐

99999 if Q25A missing

Q26 26. At the time you are seeing a patient, how often do you know what health insurance plan, if any, the patient has?

1 ☐ Usually
2 ☐ Sometimes
3 ☐ Rarely
4 ☐ Never

Q27 27. At the time you see a patient, how often are you aware of the rules that determine how their plan reimburses for services?

1 ☐ Usually
2 ☐ Sometimes
3 ☐ Rarely
4 ☐ Never

The next questions ask about the use of electronic records in your main practice.

Q28 28. In your practice, do you use electronic medical records (not including billing records)?
(CHECK ONE BOX)

1 ☐ Yes, all electronic
2 ☐ Yes, partially electronic
3 ☐ No **(SKIP TO Q30)**

29. Which of the following capabilities does your practice's EMR include?
(CHECK ALL THAT APPLY)

Q29C1 ☐ Patient demographic information
C2 ☐ Computerized orders for prescriptions
C3 ☐ Lab results
C4 ☐ Clinical notes
C5 ☐ Imaging results
C6 ☐ Decision support in the form of prompts or reminders when the physician is seeing a patient

99999 - where Q28=3

Q30 30. In your practice, do you receive an alert or prompt when follow-up care is needed for a patient?

1 ☐ Yes, using a computerized system
2 ☐ Yes, using a manual system
3 ☐ No → 30a. Do you plan to implement a system in the next 12 months? Q30a
☐ Yes 1
☐ No 2

99999 where Q30≠3

Primary care physicians are increasingly dealing with the management of chronic diseases such as asthma. The following questions ask how you care for your patients with asthma.

31. Among your patients with **mild persistent asthma**, please estimate the percentage you have prescribed:

Q31a Daily inhaled steroids, year-round

(a) ☐ 0% (1) ☐ 1 - 25% (2) ☐ 26 - 49% (3) ☐ 50% (4) ☐ 51 - 75% (5) ☐ 76 - 100% (6)

Q31b Daily inhaled steroids, seasonally or for short periods (weeks or months)

(b) ☐ 0% (1) ☐ 1 - 25% (2) ☐ 26 - 49% (3) ☐ 50% (4) ☐ 51 - 75% (5) ☐ 76 - 100% (6)

Q32 32. Among your patients, which do you think is the **most** important barrier to adherence to daily inhaled steroids? **(CHECK ONE BOX)**

1 ☐ Inconsistent family or household routines for using the medication
2 ☐ Not understanding that inhaled steroids need to be used as daily controller medications
3 ☐ Competing family issues (such as housing or job problems, income instability)
4 ☐ Concerns about inhaled steroid side effects
5 ☐ Other (please specify): _____

Section 2: Patient Vignettes

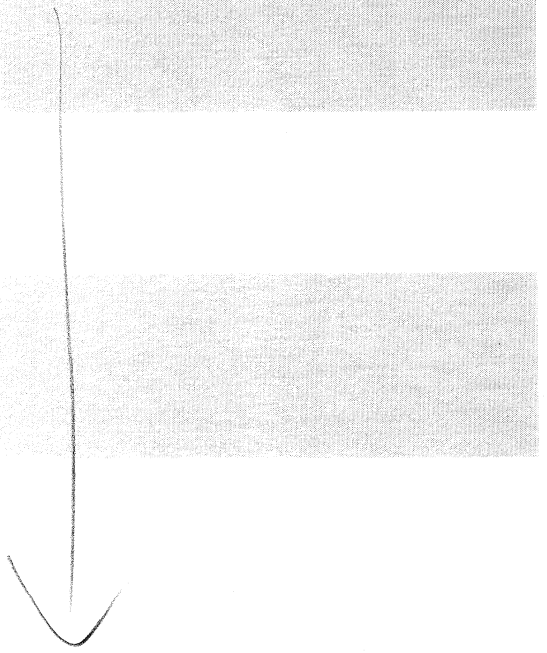
In this section, we will present the case histories for two hypothetical patients and ask how you would treat them.

Case 1

Summary
Q33A → adult
A 1A
1B
1C
} not asked for ADULTS

Summary
Q33P → Pediatric → ΣQ33P1A-C, by 4 categories
P1A
P1B
P1C

See Vignettes for Var Names



37. What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY)**
- ☐ No medical therapy
- ☐ Start sleep agent
- ☐ Start antidepressant medication
- ☐ Start anti-anxiety medication

38. Would you schedule the patient for a follow-up visit?
- ☐ Yes → 38a. In how many weeks? _____
- ☐ No

39. How much were your management recommendations described above influenced by concerns about compliance?
- ☐ A lot
- ☐ Somewhat
- ☐ A little
- ☐ Not at all

Case 2

40. Which would you include as part of this initial visit? **(CHECK ALL THAT APPLY)**
- ☐ Assess peak flow in your office
- ☐ Perform pulmonary function testing (spirometry) in the office
- ☐ Order pulmonary function tests at a local pulmonary lab
- ☐ Order in vitro allergy tests (RAST)
- ☐ Refer to asthma specialist (pulmonologist) or allergist
- ☐ Provide written asthma care plan
- ☐ Other (please specify): _____
- ☐ No action

41. What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY)**

- ☐ No medical therapy
- ☐ Albuterol MDI
- ☐ Cromolyn sodium MDI
- ☐ Oral corticosteriod
- ☐ Inhaled corticosteroids seasonally or for short periods
- ☐ Inhaled corticosteroids year-roud
- ☐ Leukotriene modifier
- ☐ Other (please specify): _____

43. Would you schedule the patient for a follow-up visit?

- ☐ Yes → 43a. In how many weeks? _____
- ☐ No

Section 3: Practice Revenues

These questions ask about the revenue your main practice earns from providing medical care. If you can provide an estimate, please do. If you have no information about revenues and managed care payments, please respond "Don't Know."

Q45 45. In 2006, what percentage of your main practice's patient care revenue came from managed care contracts, including HMOs, PPOs, IPAs and Medicaid or Medicare services delivered through managed care plans? **(IF NONE ENTER 0 AND SKIP TO QUESTION 52 ON NEXT PAGE)**

_____% or ☐ Don't Know

Q46 46. What was this percentage 3 years ago? Q46DKREF

_____% or 1 ☐ Don't Know
2 ☐ Practice did not exist 3 years ago.

99999 where Q45=0 77777 if DK, 88888 if practice dentist 3yrs ago

Q47 47. What percent of your main practice's total patient care revenues were capitated in 2006? **(ENTER 0 IF NONE)**

_____% or ☐ Don't Know

99999 where Q45=0

48. What was the share of total managed care revenues earned from each of the following: **(ENTER 0 IF NONE)**

99999 where Q45=0

Q48_1 Medicare managed care _____% or ☐ Don't Know
_2 Medicaid managed care _____% or ☐ Don't Know
_3 Other public managed care _____% or ☐ Don't Know

Q49 49. How many managed care contracts did the practice have in 2006?

_____ contracts or ☐ Don't Know

77777 where DK=1 99999 where Q45=0

Q50 50. What percentage of managed care revenue came from the practice's **largest** managed care contract in 2006?

_____% or ☐ Don't Know

77777 where DK=1 99999 where Q45=0

51. Please answer the following questions about your private, **commercial managed care** contracts (excluding Medicare or Medicaid).

What percentage of:	%	Don't Know
Q51a a. Receivables have been outstanding more than 120 days?	_____	☐
Q51b b. Claims were initially denied in this last year (2006)?	_____	☐
Q51c c. Claims were ultimately rejected in this last year (2006)?	_____	☐

77777 if DK=1
99999 " Q45=0

Q52

52. In a typical month, what percentage of your time do you provide uncompensated, or "charity" care, in your main practice? (Please do not include bad debt, or patients for whom you expected payment but did not receive it.)

_____%

Q53

53. In a typical month, do you provide charity care to patients in a setting outside your main medical practice?

1 ☐ Yes → 53a. Approximately how many hours per month? 99999 where Q53 ≠ 1
2 ☐ No Q53a

Q54

54. On average, what is your net fee after discount for an initial office visit with a private, commercially insured-patient? Q54 summary = summary var

$ _____ or ☐ Don't Know

Q55

55. What were the practice's total operating expenses for 2006, to the nearest $1,000?

$ _____ or ☐ Don't Know Q55 summary

Q56

56. What were the practice's total net earnings in 2006, to the nearest $1,000? Q56 summary

(Please enter a negative number to indicate a loss.)

$ _____ or ☐ Don't Know

Q57

57. Compared with three years ago, are the practice's current net earnings:

1 ☐ Higher
2 ☐ About the same
3 ☐ Lower
4 ☐ Don't Know
5 ☐ Practice did not exist 3 years ago

Q52 - Q57 not managed care specific, so Q45=0 not restrictive summary 62 where Q45=0,

Section 4: Income and Revenue

The following questions are about your earnings from your medical practice. This survey and its sponsors adhere to strict confidentiality procedures. Your identity as a respondent will not be revealed and only summary figures will be published.

Q58

58. How many weeks did you work in 2005?

_____weeks or ☐ Don't Know

Q59

59. How did your earnings from medical practice in 2005 compare to your earnings in 2002?

1 ☐ My 2005 earnings were higher → By what percent? Q59A → these can be 7100 & <0
2 ☐ About the same
3 ☐ My 2005 earnings were lower → By what percent? Q59A
4 ☐ Don't Know

Q60

60. Compared to your 2005 earnings, do you expect your 2006 earnings to be:

1 ☐ My 2006 earnings will be higher → By what percent? Q60A
2 ☐ About the same
3 ☐ My 2006 earnings will be lower → By what percent? Q60A
4 ☐ Don't Know

Q61

61. What percent of your 2005 earnings was paid as flat salary?

_____% or ☐ Don't Know

62. What percent of your 2005 earnings was based directly on fees-for-services you provided, or on your productivity?

_____% or ☐ Don't Know

63. What percent of your earnings was paid on a capitated basis?

_____% or ☐ Don't Know

64. What percent of your 2005 earnings was in the form of pay-outs from withholds, practice bonuses, or other incentive payments, including pay-for-performance bonuses?

_____% or ☐ Don't Know

65. Were these payments influenced by your individual performance, the practice's overall performance, both, or neither?

1 ☐ Individual performance only
2 ☐ Practice's overall performance only
3 ☐ Both
4 ☐ Neither/no bonuses

Q66

66. Does your practice participate in managed care contracts that include pay-for-performance?

1 ☐ Yes
2 ☐ No **(SKIP TO QUESTION ~~68~~)** 69
3 ☐ Don't Know **(SKIP TO QUESTION ~~68~~)** 69

Q67 C1

67. The pay-for-performance payment I received in 2005 is based on: **(CHECK ALL THAT APPLY)**

C1 ☐ Patient satisfaction surveys
C2 ☐ Preventative care delivered
C3 ☐ Use of electronic medical records or health information technology
C4 ☐ None of the above

99999 where Q66 ≠ 1

Q68

68. Are your pay-for-performance goals adjusted for the severity of illness of your patients?

1 ☐ Yes
2 ☐ No
3 ☐ Don't Know

99999 where Q66 ≠ 1

Q69

69. In 2005, what was your total income from practicing medicine, after expenses, but before taxes?

$ _____ or Don't Know

(IF YOU ARE NOT AN OWNER OF YOUR PRACTICE, PLEASE SKIP TO SECTION 5 ON THE NEXT PAGE)

Q70

70. During the past 3 years, did you make any contributions to the capital of your practice to finance on-going operations?

1 ☐ Yes
2 ☐ No

99999 if Q14 ≠ 1,2
66666 " " ≠ 1,2 and Q70 ≠ .

Section 5: Administrative Controls

The following questions ask about clinical activities that might be profiled or tracked.

71. Please indicate what percentage of the following activities are tracked by managed care organizations. **(ENTER 0 IF NONE)**

What percentage of these activities are tracked by managed care organizations?	%	Don't Know
Q71a a. Referrals to specialists	____	☐
Q71b b. Orders for diagnostic services	____	☐
Q71c c. Drug prescriptions	____	☐

= 77777 where DK = 1

Q72

72. Compared to 3 years ago, would you say that the patients you treat without referral are:

1 ☐ Much more ill than before
2 ☐ Somewhat more ill
3 ☐ Unchanged
4 ☐ Somewhat less ill
5 ☐ Much less ill

Q73

73. For patients requiring referrals to specialists, what percent of the time are you unable to obtain appropriate referrals?

_____% or ☐ Don't Know

Q74

74. What percentage of the time are you unable to prescribe drugs which you think are the most appropriate?

_____% or ☐ Don't Know

Section 6: Physician Background

Q75 75. Are you currently married or living with a partner?

1 ☐ Yes
2 ☐ No **(SKIP TO QUESTION 77)**

Q76 76. Is your spouse or partner employed?

1 ☐ Yes
2 ☐ No

Q77 77. Do you have any children under the age of six living in your household?

1 ☐ Yes
2 ☐ No

Q78 78. Are you of Hispanic, Latino, or Spanish background?

1 ☐ Yes
2 ☐ No

79. Which of the following would you consider your race? **(CHECK ALL THAT APPLY)**

Q79C1 — ☐ White
C2 — ☐ Black or African/American
C3 — ☐ American Indian, Eskimo, or Aleut
C4 — ☐ Asian or Pacific Islander
C5 — ☐ Other (please specify) _____

Thank you very much. We greatly appreciate your participation. Please return your completed questionnaire in the enclosed postage-paid envelope, or fax it to Katherine Ballard at 1-800-786-4816.

Section 2: Patient Vignettes

In this section, we will present the case histories for two hypothetical patients and ask how you would treat them.

Case 1

Gladys, a 54 year old African-American woman, arrives late for a scheduled visit for hyperlipidemia. She was doing well at her last visit, 6 months ago. She complains of 2 months of daily fatigue and trouble concentrating, despite sleeping 10 hours a night. She does not recall any precipitant for these symptoms. She "can't be bothered" to make it to her PTA committee, which she used to enjoy, and finds herself falling behind on chores around the house. She reports no other active problems, and no suicidal ideation.

Past Medical History: Chronic low back pain. Hyperlipidemia (diet-controlled).
Medications: Motrin prn
Social History: Married, school teacher. No smoking or alcohol.
Physical Exam: Somewhat irritable, mildly obese. Weight 170 pounds, up 8 pounds from last visit. Otherwise a comprehensive physical exam is unremarkable.
Labs: Lipid panel (fasting) from last week within desired range.

33 → NOT ASKED in adult vignettes

34. How likely or unlikely is it that her overall clinical picture is due to a non-psychiatric medical condition?

1 G Very likely
2 G Likely
3 G Unlikely
4 G Very unlikely

35. How likely or unlikely is it that her overall clinical picture is due to depression?

1 G Very likely
2 G Likely
3 G Unlikely
4 G Very unlikely

36. What would you do today for this patient's complaints? **(CHECK ALL THAT APPLY.)**

C1 G Observe, reassess at next visit (no other intervention today)
C2 G Order blood tests
C3 G Refer for testing for learning disability
C4 G Refer to mental health provider
C5 G Provide counseling myself
C6 G Other: _____

Case 1: A—black, B—hisp, C—white | Case 2: white, black, his, all ♀

37. What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY.)**

C1 G No medical therapy
C2 G Start sleep agent
C3 G Start antidepressant medication
C4 G Start anti-anxiety medication

38. Would you schedule the patient for a follow-up visit?

1 G Yes → 38a. In how many weeks? _____
2 G No

39. How much were your management recommendations described above influenced by concerns about compliance?

1 G A lot
2 G Somewhat
3 G A little
4 G Not at all

9-legit skip

Case 2

Kristen, a 25-year-old white woman arrives today for her new patient evaluation. Upper respiratory infections, cold air, and exercise exacerbate her asthma. She experiences nocturnal symptoms twice a month. She feels her asthma is well controlled and she uses her albuterol inhaler four to five times a week. One week ago, she was evaluated in a local emergency room for an asthma exacerbation associated with an upper respiratory infection. Her symptoms improved after she received a respiratory treatment. She has never required hospitalization for asthma, however, she was evaluated in an emergency room 3 years ago for asthma.

Past Medical History: Diagnosed with asthma several years ago.
Medications: PRN Albuterol
Social History: Does not smoke. Has a cat at home.
Physical Exam: Pleasant woman. Appeared in no acute distress. Vital signs were normal. Lung examination was remarkable for end-expiratory wheezes.
Labs: Chest x-ray in the emergency room was normal.

40. Which, if any, would you include as part of your initial evaluation?

C1 G Assess peak flow in your office
C2 G Perform pulmonary function testing (spirometry) in the office
C3 G Order pulmonary function tests at a local pulmonary lab
C4 G Order in vitro allergy tests (RAST)
C5 G Refer to asthma specialist (pulmonologist) or allergist?
C6 G Provide written asthma care plan
C7 (next pg)
C8 " "

Adult insert A.doc

G Other _____

G No Action

41. What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY.)**

G No medical therapy

G Albuterol MDI

G Cromolyn sodium MDI

G Oral corticosteroid

G Inhaled corticosteroids seasonally or for short periods

G Inhaled corticosteroids year-round

G Leukotriene modifier

G Other: _____

42. How would you classify the severity of this patient's asthma? **(CHECK ONE BOX.)**

1 G Mild intermittent

2 G Mild persistent

3 G Moderate persistent

4 G Severe persistent

5 G Don't know

9 - Legit skip

43. Would you schedule the patient for a follow-up visit?

1 G Yes →

43a. In how many weeks? _____

2 G No

9 - Legit skip

44. What do you think is the most important factor contributing to this patient's condition?

1 G Insufficient prior therapy

2 G Insufficient patient education

3 G Patient underestimation of her condition

4 G Lack of environmental control

5 G Physician underestimation of severity of disease

6 G Other: _____

9 - Legit skip

Section 2: Patient Vignettes

In this section, we will present the case histories for two hypothetical patients and ask how you would treat them.

Case 1

Elena, a previously healthy 13-year-old Latina girl, sees you for evaluation of stomach pain, headaches and fatigue for several months. Her mother says her daughter often complains about being sick. She had been an above-average student, but now gets poor grades. She often naps during the day and recently quit the school chorus because she was "too tired." She often has difficulty sleeping at night. She denied drug or alcohol use. Recent medical evaluation, including blood work, was normal.

Past Medical History: No major illnesses. Menarche at age 12 years.
Family History: Non-contributory.
Social History: Lives with brother and mother.
Physical Examination: Height is 50th percentile; weight is 75th percentile, up 8 pounds since last year. She is quiet during the interview, and says she feels "fine." The physical examination is normal.

33. How likely or unlikely is it that her overall clinical picture is due to a typical adolescent developmental response to an underlying family or social issue?

1 G Very likely
2 G Likely
3 G Unlikely
4 G Very unlikely

34. How likely or unlikely is it that her overall clinical picture is due to a non-psychiatric medical condition?

1 G Very likely
2 G Likely
3 G Unlikely
4 G Very unlikely

35. How likely or unlikely is it that her overall clinical picture is due to depression?

1 G Very likely
2 G Likely
3 G Unlikely
4 G Very unlikely

36. What would you do today for this patient's complaints? **(CHECK ALL THAT APPLY)**

C1 G Observe, reassess at next visit (no other intervention today)
C2 G Order blood tests
C3 G Refer for testing for learning disability
C4 G Refer to mental health provider
C5 G Provide family guidance or counseling myself
C6 G Other: _____

37. What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY)**

C1 G No medical therapy
C2 G Start sleep agent
C3 G Start antidepressant medication
C4 G Start anti-anxiety medication

38. Would you schedule the patient for a follow-up visit?

1 G Yes → 38a. In how many weeks? _____
2 G No

39. How much were your management recommendations described above influenced by concerns about compliance?

1 G A lot
2 G Somewhat
3 G A little
4 G Not at all

Case 2

Darnell, a 9-year-old African-American boy, arrives with his mother for a new patient visit. He was diagnosed with asthma 2 years ago. In the past year, he has had 2 emergency room visits, one hospitalization, and 1 short course of oral steroids. He has some wheeze and cough 2 to 3 times a week and awakens once or twice a month with cough. His mother states it "doesn't seem to bother him." He gets albuterol nebulizer treatments for his coughing and wheezing episodes.

Family History: One older sibling with a history of wheezing.
Allergies: No known drug, food or seasonal allergies.
Social History: There is a cat at home. Patient's mother smokes cigarettes.
Physical Exam: His weight for height is above the 75th percentile. He has no audible wheezing.

Ped insert B.doc

40. Which would you include as part of this initial visit? **(CHECK ALL THAT APPLY)**

- C1 — G Assess peak flow in your office
- C2 — G Perform pulmonary function testing (spirometry) in the office
- C3 — G Order pulmonary function tests at a local pulmonary lab
- C4 — G Order in vitro allergy tests (RAST)
- C5 — G Refer to asthma specialist (pulmonologist) or allergist
- C6 — G Provide written asthma care plan
- C7 — G Other: _____
- C8 — G No action

41 What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY)**

- C1 — G No medical therapy
- C2 — G Albuterol MDI
- C3 — G Cromolyn sodium MDI
- C4 — G Oral corticosteriod
- C5 — G Inhaled corticosteroids seasonally or for short periods
- C6 — G Inhaled corticosteroids year-round
- C7 — G Leukotriene modifier
- C8 — G Other: _____

42. How would you classify the severity of this child's asthma? **(CHECK ONE BOX)**

- 1 G Mild intermittent
- 2 G Mild persistent
- 3 G Moderate persistent
- 4 G Severe persistent
- 5 G Don't Know
- 9 - log it skip

43. Would you schedule the patient for a follow-up visit?

- G Yes → 43a. In how many weeks? _____
- G No

44. What do you think is the most important factor contributing to this patient's condition? **(CHECK ONE BOX)**

- 1 G Insufficient prior therapy
- 2 G Lack of environmental control
- 3 G Parental underestimation of patient's condition
- 4 G Insufficient parental education about patient's condition
- 5 G Physician underestimation of severity of disease
- 6 G Other: _____.

9 - log it skip

Asthma Vignette:

Todd, a 9-year-old white boy, arrives with his mother for a new patient visit. He was diagnosed with asthma 2 years ago. In the past year, he has had 2 emergency room visits, one hospitalization, and 1 short course of oral steroids. He has some wheeze and cough 2 to 3 times a week and awakens once or twice a month with cough. His mother states it "doesn't seem to bother him." He gets albuterol nebulizer treatments for his coughing and wheezing episodes.

Family History: One older sibling with a history of wheezing.
Allergies: No known drug, food or seasonal allergies.
Social History: There is a cat at home. Patient's mother smokes cigarettes.
Physical Exam: His weight for height is above the 75th percentile. He has no audible wheezing.

---

40. Which would you include as part of this initial visit? **(CHECK ALL THAT APPLY)**

G Assess peak flow in your office

G Perform pulmonary function testing (spirometry) in the office

G Order pulmonary function tests at a local pulmonary lab

G Order in vitro allergy tests (RAST)

G Refer to asthma specialist (pulmonologist) or allergist

G Provide written asthma care plan

G Other: _____

G No action

41. What, if any, medical therapies would you recommend now? **(CHECK ALL THAT APPLY)**

G No medical therapy

G Albuterol MDI

G Cromolyn sodium MDI

G Oral corticosteriod

G Inhaled corticosteroids seasonally or for short periods

G Inhaled corticosteroids year-round

G Leukotriene modifier

G Other: _____

42. How would you classify the severity of this child's asthma? **(CHECK ONE BOX)**

G Mild intermittent

G Mild persistent

G Moderate persistent

G Severe persistent

G Don't Know

43. Would you schedule the patient for a follow-up visit?

G Yes → 43a. In how many weeks? _____

G No

44. What do you think is the most important factor contributing to this patient's condition? **(CHECK ONE BOX)**

G Insufficient prior therapy

G Lack of environmental control

G Parental underestimation of patient's condition

G Insufficient parental education about patient's condition

G Physician underestimation of severity of disease

G Other: _____.