Buying Loyalty:
Theory and Evidence from Physicians

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[JOB-MARKET PAPER]

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October 26, 2012

Abstract

We study the use and impact of non-compete agreements (NCAs), which restrict workers from exiting a firm and competing against it, among skilled-services firms where information asymmetries create search frictions. NCAs provide a mechanism for separating the implicit assignment of property rights over client loyalty that is otherwise tied to production. We present a theoretical model that describes how NCAs affect bargaining power between workers and firms, increase productive efficiency, and reduce turnover. These direct effects lead to compensation contracts that are more productivity-based, have higher earnings, higher returns to tenure, and stronger incentives for training and intra-firm client referrals. Using survey data from physicians we find that NCAs are used frequently, variation in usage is consistent with theory, empirical evidence supports the predictions on contract structures and earnings, and the magnitudes of effects vary with the strength of state laws on NCA enforceability. Although NCAs may appear to improve social welfare as a personnel policy, the net effect is ambiguous because of the possibility that they also reduce competition in output markets and increase prices.

JEL Classifications: J60, J30, K31

Keywords: Non-Compete Agreements, Incentive Contracts, Human Capital

*An earlier version of this paper is contained in the second chapter of Lavetti's graduate dissertation at Cornell University, and he is grateful to Nicholas Kiefer, George Jakubson, Lawrence Kahn, and Kosali Simon for their guidance. We also thank Nicholas Bloom, David Card, Patrick Kline, Matt Marx, Justin McCrary, Jesse Rothstein, Alan Sorensen, Amanda Starc and participants at AHEC, Northwestern Kellogg; ASHE; and APPAM for helpful comments, and Norman Bishara for generously sharing data and legal expertise. Financial support from the Robert Wood Johnson Foundation Scholars in Health Policy Program, the Agency for Healthcare Research and Quality, and The California Endowment is gratefully acknowledged. Correspondence: lavetti@berkeley.edu.

1 Introduction

Firms that provide skilled services face unusual difficultly in 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 services, where information asymmetries between clients and workers makes search costly and generates loyalty. Skilled workers that leave a service firm often have the ability to take customers with them to another firm in the market. As a result, service firms that face opportunities to invest in increasing the output of their workers or in expanding their client base may fail to do so if they cannot control their relationship-assets.[1] While they may not be able to control their relationship-assets directly, high-skilled service firms can instead mitigate investment holdup problems using personnel policies to control the rights of the worker over the asset.[2]

This paper examines how non-compete agreements (NCAs)[3] can alleviate inefficiencies that may arise in service firms that cannot control their relationship-assets in more conventional ways. NCAs are elements of employment contracts that prevent workers from exiting a firm and then competing against it. In the context of physicians, NCAs prohibit a physician who leaves a group practice from practicing medicine anywhere within a specified geographic market for fixed period of time, generally several years.[4] While indirect, NCAs allow the firm to transitively control valuable relationship-specific assets by making them worthless outside of the firm. However, this control comes at the cost of restricting the choice set of workers, which can create distortions in labor markets.

At face-value, the distortions caused by NCAs seem to be inefficient. Most directly, NCAs impose exit barriers on workers that increase the cost of mobility. If workers and firms cannot commit to self-enforcing long-term labor contracts, then higher mobility costs give firms ex post monopsony power over workers that are bound by NCAs.[5] When earnings are renegotiated firms can exploit this power to reduce earnings (or earnings growth), flattening the wage-tenure profile. Workers who anticipate these dynamic effects of NCAs on bargaining power may require front-loaded contracts, which can lead in turn to inefficiently high levels of turnover. In addition, NCAs have the potential to reduce competition in output markets.[6]

However, there are also ways in which NCAs could improve social welfare. NCAs allow firms to allocate relationship-assets across workers without the risk that a worker will leave the firm and

[1] As Grossman and Hart (1986) describe, contracts that do not fully allocate rights of control over the assets of a firm can lead to holdup problems in investment.

[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] NCAs are also known as covenants not-to-compete.

[4] See Section 3 for more details on the structure and enforceability of NCAs in medicine.

[5] See Boal and Ransom (1997).

[6] To the extent that they deter entry of potential competitors, from either within and outside the firm, NCAs may increase the size of firms and concentration of markets, which could increase prices and limit the choices of consumers. We discuss the potential effects of NCAs on firm structure and competition in output markets in greater detail in Appendix A

take the client with them. If workers are specialized, this can improve matching between clients and workers. Removing the externality of client interaction on asset control can also allow the firm to more optimally allocate clients across firm owner-agents and employees, increasing the productive efficiency of the firm. In addition, NCAs have the potential to mitigate the effects of pre-existing labor market inefficiencies. They may either causally lengthen the average duration of job spells by imposing exit barriers on workers, or induce self-selection by workers with private knowledge of their own propensity to leave the firm and compete against it. In markets where hiring is costly, increasing job spell duration raises total welfare, and the gains are distributed between workers and consumers.[7] If the costs of turnover or the benefits of asset ownership vary across firms, self-selection by workers can also improve the matching between workers and firms. NCAs can also provide insurance against the unraveling of partnerships, as we discuss further in Appendix A.[8]

We develop a theoretical model in Section 2 that expands upon these ideas. The foundation of the theory is similar to Grossman and Hart (1986) and Hart and Moore (1990), which model the role of property rights in firms' investment decisions in relationship-specific assets. More broadly, the model also relates to general theories of firm investment in human capital beginning with Becker (1962), and subsequent refinements that examine the effects of labor market distortions, such as Acemoglu and Pischke (1999). While such distortions can make skills that are "technologically general" de facto specific, we model the unique situation of service firms that can choose ex ante whether to make investments general or specific by imposing an NCA. The key consequence of the ex ante decision is that the full menu of contractual options is negotiated jointly with the decision to make human capital investments either general or specific. In addition, we show that when turnover is relatively costly and long-term contracts are not credible, commitments to productivity-based piece-rate linear compensation contracts can overcome the effects of dynamic changes in bargaining power without front-loading compensation. This explanation for the use of the use of piece-rate compensation contracts has not, to our knowledge, been discussed in the literature on sharing contracts, which has focused on moral hazard, risk sharing, and imperfect financial markets.[9] We show that sharing contracts are more strongly tied to output when accompanied by NCAs, and necessarily increase the expected returns to tenure. Consequently, when separations are endogenously determined by on-the-job search, NCAs increase the expected length of job spells, reducing aggregate hiring costs.

Using new survey data from 1,967 primary care physicians in 5 states (CA, GA, IL, PA, and TX), we provide the first micro-level evidence of the systematic use of NCAs by skilled service firms. Even outside of service firms, there is relatively little prior empirical evidence on the use of NCAs. Prior research has focused on the use of NCAs among technical professionals involved in the development and use of proprietary intellectual property, Marx et al (2009) and Marx (2011),

[7] As shown in Salop and Salop (1976)

[8] In Appendix A we present a model of partnerships with free entry and endogenous use of NCAs that builds upon theories of partnerships by Ward (1958), Farrell and Scotchmer (1988), and Levin and Tadelis (2005).

[9] See Stiglitz (1974), Gibbons (1987), Gibbons and Murphy (1992), and Signh (1987).

and high-level corporate executives, Garmaise (2011). We find that about half of employed primary care physicians in the sample are bound by NCAs, and that variation in the use of NCAs across physicians, practice types, and markets is consistent with economic theory.

We then empirically test the hypotheses from the theoretical model. We find that physicians with NCAs negotiate contracts with incentive components tied to individual output that are more than twice as large, relative to total earnings, as physicians without NCAs. Firms that use NCAs have a much more uniform distribution of patients across part-owners and workers, with the difference in average weekly patient-visits more than twice as large in firms that do not use NCAs. In addition, firms that use NCAs are able to retain more valuable privately-insured and Medicare patients, and treat relatively fewer Medicaid or uninsured patients. These two factors lead to enormous differences in the productivity of employed physicians with and without NCAs: physicians with NCAs are over 40% more productive, measured by revenue generated per hour, and the mean difference is even larger conditional on physician characteristics.

We also test for evidence that NCAs reduce investment holdups. Using variation in earnings over time, we estimate that NCAs increase the rate of within-job real earnings growth, controlling for unobserved worker and firm match effects, by about 22 percentage points. Moreover, we find no evidence of positive within-job earnings growth at all for physicians who do not have NCAs. Using a two-step model to account for endogeneity due to job search behavior that may be correlated with unobserved firm effects, we decompose the total earnings growth into the component due to returns to experience and the component from returns to firm tenure. This decomposition provides evidence on the mechanisms through which NCAs affect earnings growth. Investments in mentoring or training to increase general human capital that is transferrable to other firms should increase the returns to experience, while investments in firm-specific human capital, including client allocations to physicians with NCAs, should increase returns to job tenure. We find that NCAs significantly increase both forms of earnings growth. About 10 percentage points of the difference in growth is due to returns to experience and 12 percentage points due to firm tenure. We also show that NCAs are associated with significantly longer job-spells, and present evidence that suggests that part of the difference is likely to be causal while part is due to sorting on unobservable preferences for mobility. Either effect is of value to the firm. The magnitude of the cumulative earnings difference over a job-spell is much larger than plausible estimates of reductions in hiring costs, implying that differences in turnover alone cannot explain the earnings patterns. The combined evidence is consistent with the explanation that NCAs reallocate property rights to firms and reduce holdups from firm investments, such as intra-firm referrals or training.

One concern with interpreting these results as causal effects is the possibility that workers sort into jobs with NCAs based on unobserved ability. We test for this in three ways, and find no discernable relationship between the use of NCAs and the quality of physicians. First we test for differences in the prices negotiated between each physician practice and private commercial insurance compa-

nies, conditional on unobserved primary care service market effects from the Dartmouth Atlas of Health Care. We find no difference in prices charged by physicians with NCAs, both unconditionally and conditional on observable characteristics. Second, we use data from patient vignette questions that directly elicit clinical knowledge and diagnoses and treatment recommendations, and test for compliance with recommended guidelines. We find no systematic difference in either the responses to particular questions or to aggregate measures of compliance with guidelines. Finally, we test for exidence that firms that use NCAs prefer to hire physicians with more prior experience, and find precisely no difference. Collectively, this evidence suggests that any systematic difference in quality among physicians with NCAs is limited to dimensions that are neither valued by consumers nor insurance companies, are unrelated to elicited clinical knowledge, diagnosis patterns, or treatment recommendations, and are unrelated to experience.

The use of NCAs by physicians in particular is very policy-relevant. Several states[10] have changed their laws to expressly prohibit the use of NCAs by physicians, despite an absence of empirical evidence on their effects. In addition, NCAs have the potential to become an important issue in debates surrounding the implementation of the Affordable Care Act (ACA). A substantial concern about implementation of the ACA is that shifts in demand for physician services will be strongly heterogeneous due to geographic correlations in uninsurance. For example, demand may increase by substantially more in poorer urban areas than in affluent suburbs. To the extent that NCAs restrict intra-market movement, they have the potential to exacerbate disparities in access by limiting supply responses. The expansion of Accountable Care Organizations (ACOs) under the ACA has also accompanied explicit preemptive federal anti-trust exemptions for the use of exclusivity contracts, a weaker form of NCAs, between ACOs and primary care physicians, but not specialists.

The paper proceeds as follows: Section 2 presents a theoretical model of the use of NCAs in service firms. Section 3 provides background on the empirical setting and describes the data used in the analyses. Section 4 discusses the empirical methodology. Section 5 presents our results and robustness checks. Section 6 concludes and discusses the possible implications of our findings for policy and future research.

2 Theory

We discuss two perspectives on theories behind the use of NCAs. The first considers the relationships between workers and firms, focusing on the firm's problem of controlling relationship-assets, allocating clients to achieve productive efficiency, and designing incentive-compatible dynamic compensation contracts, as well as decisions by workers about effort and endogenous mobility. We then briefly discuss how NCAs might affect the optimal organizational structure of firms as partnerships or corporations, ensure the stability of partnerships against unraveling due to entry of competitors,

[10]Including CO, DE, MA, TN, and TX

and affect firm concentration in output markets. A more thorough model of this theory is provided in Appendix A.

2.1 A Model of Professional Service Firms with NCAs

We begin with a very simple two-period model that demonstrates the effect of NCAs on workers' bargaining power and the design of compensation contracts. We then introduce the opportunity for firms to make investments that increase the productivity of workers, either through allocation of assets used in production or training. Next we discuss the interactions between elastic labor supply, modeled as effort, and optimal share contracts. We then relax the assumption of exogenous job mobility, and consider the role of NCAs when hiring is costly and job switches depend on earnings.

2.1.1 Environment

A firm consists of an entrepreneur physician, indexed by subscript f, who owns the means of production, and one employed physician, indexed by w. In each period the (employed) physician performs services for a stock of patients. New physicians begin with a stock of patients A_w, which exogenously grows at the rate δ each period, as if through word-of-mouth recommendations. The production process is:

$$Y = F(A, L)$$

Assuming constant returns to scale, we write f as:

$$Y/L = F(A/L, 1) \equiv f(\ell)$$

Compensation contracts are assumed to be linear in output:

$$m = c + \alpha y$$

Firms offer compensation contracts that remain fixed unless the worker renegotiates the contract; there are no futures contracts. With probability $(1 - \rho)$ the employment relationship exogenously becomes unproductive and the worker and firm separate. Firms can impose NCAs that prevent workers from switching jobs within the market, so that if a separation occurs workers with NCAs must relocate at cost K, while workers without NCAs costlessly take their patients to a new firm. This is the feature that makes the model specific to professional service firms: due to information asymmetries patients remain loyal to their physician as long as the physician remains in the geographic market. A contract is characterized by $\{\alpha, c, \{N, C\}\}$, where N corresponds to a contract with an NCA, and C to a contract without.

Without an NCA, the firm's profit is:

$$\pi_C = \max_{\alpha_1,c_1,\alpha_2,c_2} (1-\alpha_1)f(\ell_w) - c_1 + \rho\beta(1-\alpha_2)f(\delta\ell_w) - \rho\beta c_2 + f(\ell_f) + \beta f(\delta\ell_f)$$

where $f(\ell_f)$ and $f(\ell_w)$ are the client to labor ratios of the entrepreneur and worker, respectively. The worker's reservations earnings are $\nu_1 = f(\ell_w)$ and $\nu_2 = f(\delta\ell_w)$.

With an NCA, the firm's profit function is:

$$\pi_N = \max_{\alpha,c} (1-\alpha)f(\ell_w) - c + \rho\beta(1-\alpha)f(\delta\ell_w) - \rho\beta c + f(\ell_f) + \rho\beta f(\delta\ell_f) + (1-\rho)\beta f(\delta\ell_f + \delta\ell_w)$$

2.1.2 Compensation Contracts with Sorting

We assume initially that the amount of labor supplied by each worker is fixed. Without an NCA, the worker earns

$$c_1 + \alpha_1 Y_1 = f(\ell_w)$$

in the first period, where $c_1(\alpha_1) = (1-\alpha_1)y_1$. In the second period the output of the worker is larger, $y_2 = f(\delta\ell_w)$. Since the worker can take patients to another firm in the market, reservation earnings are $f(\delta\ell_w)$. This allows the worker to renegotiate the contract in period two, such that $c_2 + \alpha_2 y_2 = f(\delta\ell_w)$. Without risk aversion, the worker is indifferent between contracts $\{\alpha_1 \in [0,1], c_1(\alpha_1), \cdot\}$ and $\{\alpha_2 \in [0,1], c_2(\alpha_2), \cdot\}$ that pay the reservation earnings in each period. In this simple model with price-takers, without an NCA there is no meaningful reason to use share-based contracts.[11] As argued by Singh (1987), it is not plausible for price-takers in a perfectly competitive model to use share-based contracts, so the contract either has a fixed wage with $\alpha = 0$ or a fixed rental price with $\alpha = 1$.

With an NCA, the reservation earnings of the worker in the second period are different. The worker cannot move patients to another firm, and so cannot use the larger stock δA to renegotiate a new contract. The reservation wage is determined by the option to switch markets, incurring cost K_i, and returning the stock of patients to A. Knowing that bargaining leverage will fall in the second period, the worker is only willing to accept a contract containing an NCA in period one if it yields an expected payoff, without renegotiation, equal to a contract without an NCA. The contract must satisfy $m_N \geq m_C$, where

$$m_N = \alpha f(\ell_w) + c + \rho\beta\alpha f(\delta\ell_w) + \rho\beta c + (1-\rho)\beta\left[f(\ell_w) - K_i\right]$$

and

$$m_C = \alpha_1 f(\ell_w) + c_1 + \beta\alpha_2 f(\delta\ell_w) + \beta c_2$$

[11] Reasons discussed in the literature for the use of piece-rate or sharecropping contracts include: moral hazard, risk aversion, and capital market imperfections (which could lead to cost sharing or screening-based explanations for the use of share-based contracts.) See Singh (1987).

The compensation contract $\{\alpha_N, (1-\alpha_N)y_N, N\}$ that yields expected earnings equal to $\{0, y_C, C\}$ in each period has

$$\alpha_N^\star = 1 + \frac{(1-\rho)\beta}{\rho\beta}\left[\frac{f(\delta\ell_w + \delta\ell_f) - f(\delta\ell_f)}{f(\ell_w) + f(\delta\ell_w)}\right] \tag{1}$$

Note that $\alpha_N^\star > 1$ implies $c_N^\star = (1-\alpha_N^\star)f(\ell_w) < 0$.

Workers thus sort into jobs with NCAs according to their preferences for remaining in the geographic market, K_i. Workers with

$$K_i \leq K^\star \equiv \frac{L}{(1-\rho)\beta}\Big[f(\ell_w)\left[\alpha - 1 + (1-\rho)\beta\right] + f(\delta\ell_w)\left[\alpha\rho\beta - \beta\right] + c\left[1+\rho\beta\right]\Big]$$

accept contracts with NCAs, and those with $K_i > K_i^\star$ prefer contracts without NCAs.

Firms must also earn equal expected profits in a mixed equilibrium. $\pi_N = \pi_C$ implies $K_i^\star$ can be rewritten as:

$$K^\star = L\left[f(\ell_w) - f(\delta\ell_f) + f(\delta\ell_f + \delta\ell_w) - \frac{\rho\beta}{(1-\rho)\beta}f(\delta\ell_w)\right] \tag{2}$$

This simple model demonstrates two points: (1) although NCAs decrease workers' bargaining power, there exists a linear compensation contract that equates expected earnings in all periods, even if there are no forward contracts, and (2) linear compensation contracts are more share-based when NCAs are used:

$$\alpha_N^\star > \alpha_C^\star$$

where α_C is the share in a contract without an NCA.

2.1.3 Property Rights and Productive Efficiency

We now consider the firm's choice of the allocation of clients, A. The entrepreneur can refer clients to the employed worker, increasing ℓ_w and decreasing ℓ_f. There are several reasons why the allocation decisions of the entrepreneur may have consequences for productive efficiency. Client referrals to workers may occur either because the entrepreneur and worker are differentiated and have comparative advantages at serving different clients, or because each agent is constrained by a limited amount of time.

NCAs can provide firms with a mechanism to reduce productive inefficiencies caused by such investments holdup problems by implicitly leasing clients to employed workers rather than transferring ownership of these intangible assets. To see this, consider the first order conditions of the two firms faced with the same client allocation problem:

$$\frac{\partial \pi_C}{\partial \ell_f} = f'(\ell_f) + \beta f'(\delta\ell_f) = 0$$

so the entrepreneur retains all of the firm's clients as long as the marginal product is non-negative.

The entrepreneur who imposes NCAs faces a different first order condition:

$$\frac{\partial \pi_N}{\partial \ell_f} = f'(\ell_f)+\rho\beta f'(\delta\ell_f)-\frac{\partial \alpha}{\partial \ell_f}f(\ell_w)+(1-\alpha)\frac{\partial f(\ell_w)}{\partial \ell_f}-\frac{\partial c}{\partial \ell_f}-\rho\beta\frac{\partial \alpha}{\partial \ell_f}f(\delta\ell_w)+\rho\beta(1-\alpha)\frac{\partial f(\delta\ell_w)}{\partial \ell_f}-\rho\beta\frac{\partial c}{\partial \ell_f} = 0$$

where $f'(\ell_f) > 0$ but $\frac{\partial f(\ell_w)}{\partial \ell_f} < 0$ since total stock of patients $\bar{\ell} = \ell_f + \ell_w$ is fixed. Fixing earnings at their reservation value and implicitly differentiating gives:

$$\frac{\partial \alpha}{\partial \ell_f} = \frac{-f(\ell_w) - \rho\beta f(\delta\ell_w)}{\alpha\frac{\partial f(\ell_w)}{\partial \ell_f} + \alpha\rho\beta\frac{\partial f(\ell_w)}{\partial \ell_f}} > 0$$

and

$$\frac{\partial c}{\partial \ell_f} = \frac{-1 - \rho\beta}{\alpha\frac{\partial f(\ell_w)}{\partial \ell_f} + \alpha\rho\beta\frac{\partial f(\ell_w)}{\partial \ell_f}} > 0$$

The first order condition thus implies:

$$f'(\ell_{Nf}) + \beta f'(\delta\ell_{Nf}) > f'(\ell_{Cf}) + \beta f'(\delta\ell_{Cf})$$

which implies that

$$\ell^\star_{Nf} < \ell^\star_{Cf} \quad \text{and} \quad \ell^\star_{Nw} > \ell^\star_{Cw}$$

The worker at the firm that uses NCAs receives more clients and has higher output. The increase in productive efficiency occurs because the NCA allows the entrepreneur to decrease the difference between his own asset-labor ratio and that of the worker. As shown by Cheung (1968, 1969) and discussed further by Reiersen (2001), productive efficiency with linear contracts occurs if the firm makes the labor input decision, which we have abstracted from to this point. Thus the asset-labor ratio of the entrepreneur and the employee will not generally be equal unless the worker has an NCA and either $\alpha = 0$ or the entrepreneur chooses the amount of labor to be provided. Still, the difference in asset-labor ratios cannot possibly be further than they are in the case of no NCAs as this would require the entrepreneur to transfer all of the assets of the firm to the worker, which is not an incentive-compatible outcome. The net effect is that NCAs increase the productive efficiency of the firm, but the requirement that NCAs be paired with linear contracts (due to their effects on bargaining power) creates an inefficiency unless firms can choose the amount of labor supplied. Otherwise, for example if monitoring is costly, the inefficiency of linear contracts is a form of transaction cost caused in part by the absence of a competitive market for clients.

There is also close parallel worth drawing attention to between client referral decisions within firms and firm investments in worker training. Indeed referrals to inexperienced workers may have a direct element of general training. In addition, although clients are free to choose their agents, referrals likely increases the probability that the referred worker is chosen. The possibility that this

will lead to an enduring relationship is a valuable intangible asset to the worker, and the key feature of the asset is that it is generally transferable to other firms in the market due to search frictions and information asymmetries. That is, referral decisions within a firm have a direct effect on the worker's outside option earnings if the worker is not bound by an NCA, but has no effect on the outside option if the worker has an NCA.

Despite the benefit to the worker of a referral, the firm of the referring agent may be unable to extract the rents from the referral directly, often because ethics or laws prevent kickback payments for referrals.[12] NCAs provide insurance to the firm that the benefits of such referrals will be retained by the firm by transforming the generally transferable asset into a de facto firm-specific asset. The literature on worker training suggests that firms will not invest in productivity increases that are generally transferable to other firms, unless there are labor market inequalities that induce wage compression, but they will invest in productivity increases that are specific to the firm. The intuition behind this result holds identically for client referrals, and NCAs offer a mechanism for firms to retain property rights over intangible assets and thus internalize investments in productivity increases through referrals. NCAs may also increase the incentive for other types of investments in productivity increases, such as advertising the availability of new workers, that may be generally transferable without an NCA.

2.1.4 Elastic Labor Supply

If labor supply is elastic the output of workers with NCAs increases further relative to workers without NCAs, but can have ambiguous effects on productive efficiency. Suppose workers provide effort, e, that augments output per labor input[13]:

$$e\frac{Y}{L} + \varepsilon = ef(\ell) + \varepsilon$$

Effort costs $g(e)$, with the usual properties, $g(0) = 0$, $g'(e) > 0$, and $g''(e) > 0$. Effort is not directly observable, and cannot be inferred from output because production is stochastic due to ε. We abstract from risk aversion, which has been thoroughly discussed in the literature on linear

[12] Kickback payments for referrals are generally illegal in medicine, for example. There may be some limited exceptions to this law if the purchase of a stock of patients is done implicitly through equity investments in firms, which could still substantially limit such arrangements.

[13] While we have assumed the number of hours worked to be fixed, NCAs may also affect hours worked and the elasticity of labor supply for several reasons. The direct effect on hours comes from larger allocation of clients. Hansen and Imrohoroglu (2009) show that when the impact of learning by doing is greater, labor supply is more elastic. Thus if the net effect of NCAs on the slope of the wage profile is positive, workers with NCAs are likely to have higher intertemporal substitution elasticities of labor supply. An indirect reason why hours may be affected by NCAs is that the undesirable restrictions imposed by an NCA are independent of the number of hours worked. Unlike undesirable non-wage job characteristics that occur in proportion to the number of hours worked, like occupational hazard rates, NCAs impose a fixed cost. To the extent that workers are compensated for accepting NCAs, firms may prefer to spread this additional compensation over a greater number of hours of work.

contracts.[14] Workers choose effort to solve:

$$m_N = \max_{e_1,e_2} \alpha e_1 f(\ell_w) + c + \rho\beta\alpha e_2 f(\delta\ell_w) + \rho\beta c + (1-\rho)\beta\left[\nu - K^\star\right]$$

The first order conditions show that both the larger asset stock and higher value of α contribute to workers with NCAs providing greater effort in each period, $e_{1N} > e_{1C}$ and $e_{2N} > e_{2C}$. Plugging the worker's response function into the firm's asset allocation problem shows that higher effort levels associated with NCAs further increase the productive efficiency of the firm that uses NCAs, assuming workers' labor supply functions are upward sloping.[15]

2.1.5 Returns to Tenure and Endogenous Mobility

In a mixed equilibrium in which some firms use NCAs and others do not, the increase in productive efficiency associated with NCAs increases the return to tenure of workers with NCAs and decreases $K^\star$. The return to tenure increases because the expected earnings of workers with and without NCAs are equal in each period, but the cost in the second period conditional on moving is higher for workers with NCAs. Denoting the return to tenure in the two-period model by T:

$$T_C = f(\delta\ell_{Cw}) - f(\ell_{Cw})$$

$$T_N = \alpha f(\delta\ell_{Nw}) + c - \alpha f(\ell_{Nw}) - c$$

Equal expected earnings in the second period implies:

$$f(\delta\ell_{Cw}) = \rho\alpha f(\delta\ell_{Nw}) + \rho c + (1-\rho)\left[f(\ell_{Cw}) - K^\star\right]$$

Earnings conditional on $\rho = 0$ are $f(\ell_{Cw}) - K^\star < f(\delta\ell_{Cw})$, which directly implies $T_N > T_C$.

For simplicity, we have ignored transaction costs associated with hiring in the model. Hiring costs, however, can be substantial.[16] As discussed in Pissarides (1990), search frictions create match-specific rents that are allocated by bargaining between workers and firms. In models of on-the-job search, regardless of whether wage offers are exogenous or determined by a full general equilibrium,

[14] See Stiglitz (1974) and Singh (1987).

[15] Specifically, the requirement is

$$\frac{\partial e}{\partial \ell_f} = \frac{\partial e}{\partial \alpha}\frac{\partial \alpha}{\partial \ell_f} + \frac{\partial e}{\partial \ell_w}\frac{\partial \ell_w}{\partial \ell_f} < 0$$

This holds true if $\frac{\partial e}{\partial \alpha} > 0$ and $\frac{\partial e}{\partial \ell_w} > 0$, which is loosely interpreted as: workers exert more effort if their share increase and if complementary production inputs increase. The assumption may not hold if the income effect outweighs the substitution effect, and labor supply is backward bending. Empirical evidence from US physicians suggests that the uncompensated wage elasticity of labor supply is close to zero (Nicholson and Propper, 2012).

[16] Waldman et al (2004) estimate the cost of recruiting to be over $150,000 per physician based on data from a large medical center. Other estimates, such as Erra and Hogue (2009), that account for the costs of lost revenue from unfilled positions are several times higher.

hiring costs combined with higher earnings and returns to tenure make it less likely that workers will switch jobs.[17] Thus, if we were to relax the assumption of exogenous separations, hiring costs would increase the gap in wages between workers with NCAs and those without by lengthening average job-spell durations of workers with NCAs and reducing total expenses for hiring costs. The presence of hiring costs may increase the incentive for firms to impose NCAs. In addition to reducing hiring costs, Acemoglu and Pischke (1999) show that bargaining over these match-specific rents can lead to compression of the wage structure that further increases the incentive for firms to invest in worker human capital.

Note that NCAs may reduce endogenous mobility and lengthen job spells even if the direct exit barriers they impose have no causal effects whatsoever. If workers have unobservable preferences for occupational mobility within the geographic market, NCAs may provide a mechanism for firms to induce self-selection by workers. Workers who are least averse to signing a contract with an NCA are those who do not anticipate switching jobs within the geographic market, providing firms with potentially valuable information about workers' expectations.[18]

Note that although we focus our attention on geographic and occupational mobility, there is an interesting comparison to be made with prior literature, such as Fallick et al (2006), which focused on inter-industry mobility. When markets are defined by products rather than geography, NCAs can have very different types of mobility effects since workers may have to switch industries to avoid violating the contract. We ignore the possibility of inter-industry job switches because our analysis focuses on physicians, who are unlikely to switch industries due to the high fixed costs of training. This simplification can also alleviate concerns about the endogeneity of the location decisions of firms with respect to state NCA laws. Whereas technology research companies may benefit from agglomeration economies in places like Silicon Valley, where NCAs are relatively unenforceable under California law, [19] physicians and other on-site service firms locate everywhere.

2.2 Firm Organization and Competition in Output Markets

A potentially important consequence of asymmetric information in high-skilled service firms is that the reputation of the firm may be more salient than the quality of any particular worker. In this setting there are important interdependencies between firm structure and quality, which was pointed out by Levin and Tadelis (2005). Specifically, entry of new workers or firms into a market can cause partnerships to become unstable, resulting in unraveling from the top down. A recent example of

[17] See Pissarides (1990, 1994) and Devine and Kiefer (1993).

[18] An alternative possibility is that preferences for local mobility are negatively correlated with preference for long-distance mobility, in which case self-selection could lead to an ambiguous effect on the length of job-spells. As we discuss in Section 5, empirical evidence supports the former explanation, that NCAs are associated with longer job-spells.

[19] Gilson (1999) argues that differences in employee mobility patterns, a mechanism for transferring knowledge between firms, in Silicon Valley and Route 128 can be explained in part by differences in legal infrastructure, NCA laws in particular, and that efficient transfers of knowledge through mobility have played a large role in the creation and development of industrial districts.

this was the dissolution of the prominent law firm Dewey & LeBoeuf in 2012, as a group of top partners defected, leading to a wave of defections among the majority of the partners.[20] NCAs can prevent the threat of entry and the dissolution of partnerships, potentially creating broad effects on entry and competition in output markets. By preventing workers from becoming competitors and by deterring entry to the extent that entry involves hiring in local labor markets, NCAs can maintain or increase concentration in a local market, potentially raising prices to consumers. To the extent that any gains are paid to workers, this can decrease the relative returns of potential entrants to starting new firms as opposed to joining existing ones, leading to further agglomeration.

In Appendix A we present a brief reputation-based model of partnerships that builds upon Levin and Tadelis (2005) and examines the relationship between the ability of workers and the use of NCAs by firms. The simple model of partnership organization begins with workers sorting into partnerships that partition ability-space, as in Farrell and Scotchmer (1988). We then allow for free-entry of workers into the market, which can lead to the unraveling of partnerships. Finally, the model allows for the option for partners to make side-payments to other partners in the firm in exchange for all partners committing to non-compete agreements. This protects the firm from the threat of unraveling. We show that in this model, which emphasizes worker ability above all else, the use of NCAs weakens the strength of assortative matching based on ability. A relationship between the average quality of a firm and the use of NCAs would require restrictions on the third moments of the distributions of ability within firms. A more thorough discussion of the theoretical effects of NCAs on firm organization and market concentration is included in Appendix A.

3 Empirical Setting and Data

3.1 The Physician Marketplace

Physicians are commonly categorized into two main groups: primary care physicians (PCPs) and specialists. PCPs typically serve as the first point of contact for patients and, ideally, as coordinators of their care. They are usually defined as physicians in family medicine, general internal medicine, pediatrics and obstetrics/gynecology, and in this paper we focus on the first three groups. In 2008 PCPs made up 39% of practicing U.S. physicians.[21] The balance of the physician workforce consists of physicians specializing in particular areas of medicine (e.g. cardiology, orthopaedic surgery, rheumatology etc.)

Physician services are provided by medical practices. Practices are usually organized as either solo practices (a single physician, usually self-employed, practicing alone) or as group practices with

[20] The American Bar Association has deemed the use of non-compete agreements in the legal industry to be unethical and bans their use in law firms under Disciplinary Rule 2-108(A) of the ABA Model Code and Rule 5.6 of the Model Rules of Professional Conduct.

[21] Health United States 2010

multiple physicians covering one or more specialities. In group practices, physicians may be either owners or employees, and in some states it is possible that a practice may be owned by a non-physician entity such as a hospital and that all physicians in a practice may be employees. Historically, the vast majority of physicians were self-employed in solo practices, but since the 1980s there has been a rapid shift towards group practice and employee status.[22]

Practices are usually paid on the basis of their provision of services to patients. An important factor in determining patient volume is repeat purchases of care occurring as a result of relationships developed with patients and, for specialists, referring physicians.[23] Accordingly, there are incentives for practices to invest in developing these relationships and to seek to protect them from competitive threats. For solo practitioners, investments are explicit in establishing relationships with patients and/or referring physicians to build their practice. Group practices may make general investments promoting the practice, but for established groups a major component of investments is in recruiting new physicians and developing a stock of patients. This may include offering new physicians access to an existing "book" of patients.

Practices often use compensation contracts that combine a fixed salary, an individual productivity component, and a firm redistribution component. This creates incentives for a referring physician to keep patients within a practice. If physicians value both the well-being of referred patients and their own earnings, there is a preference towards referring patients to physicians within a group practice if there is a suitable physician available.[24] For referrals that occur due to comparative advantages and specialization, this incentive to impose NCAs is likely to be stronger in multi-specialty firms. Conversely, if referrals are due to capacity constraints, for example established physicians who cannot accept new patients may refer inquiring patients to newer physicians, the incentive to impose NCAs depends on the availability of unconstrained physicians with similar characteristics, and this incentive could be stronger in less differentiated practices.

From a practice's perspective, a key threat to investments in patient and/or referring physician relationships is that a physician will exit the practice and take some or all of the practice's patients with them. Historically, when solo practice was the dominant form of organization, this issue was primarily relevant when a physician sold their practice to another doctor. However, for multi-physician groups, the increasingly dominant form of organization, it is an ongoing issue that can arise any time a physician leaves the group.

[22]Kletke, Emmons and Gillis (1996) estimate that in 1984, 71% of physicians were in solo practices or two person groups and that 76% of physicians were owners or part-owners of their practices. In 2004-5, albeit using somewhat different data, Liehaber and Grossman (2007) estimated that the share of physicians in solo or two-person groups was only 33% and that overall, 45% of physicians were employees, with 19% working as employees in physician owned practices, but with 36% employed by non-physician entities. Further, more recent data (Harris 2010) suggests that the trend toward non-physician ownership of practices and employee status may be accelerating.

[23]For primary care physicians, the nature of these relationships is well captured by the phrase "my doctor". In this context, in 2008-9, over 80% of U.S. adults 18-64 reported a "usual source of care" (Health United States 2010).

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

3.2 Non-Compete Agreements in Practice

Non-compete agreements offer a mechanism for protecting a practice's investments in patient and physician relationships against the threat of physician exit by preventing a departing physicians from practicing medicine in a defined geographic area for a specified period.[25] This has the effect of assigning property rights over patients to the firm rather than the physician. Unlike NCAs for workers in areas like intellectual property, agreements are usually local in scope, reflecting the largely local character of markets for health services. Consequently, even with an NCA, a physician can generally continue to work in their chosen area of medicine without a career detour, but only if they move out of the local area and bear the associated costs. A variant in some NCA contracts allows the physician to stay, but requires them to pay damages. For example, under a 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.[26] Possible substitutes or complements for NCAs include back-loading compensation and, for part-owners, reducing claims on a practice's profits if they leave a practice. However, these mechanisms primarily serve as retention devices. In contrast, NCAs potentially can apply even in cases when the firm chooses to separate from the worker.

The use of NCAs among physicians has a long and controversial history.[27] Proponents of their use argue that medical practices should be free to write flexible labor contracts and to use NCAs to protect investments in developing patient and physician relationships. Proponents also claim that from a public policy perspective, NCAs are justified because protecting practice investments can reduce hiring costs, create incentives for physician-level investment, and potentially lower prices and improve access for services, especially in areas where physician recruitment is difficult. Critics, including organized medicine, have voiced a range of concerns about NCAs. They argue that NCAs can limit physician mobility and restrict patient choice, and can have anti-competitive effects on entry and restrain trade, possibly leading to higher prices and reduced access while placing practices in the position of being able to exercise bargaining power over physicians (Di Dio 1999.) An added dividend of NCAs is that they not only preclude competition by a physician for a practice's existing patients, but also for potential ones.

Reflecting these concerns, the American Medical Association (AMA) Council on Ethical and Judicial Affairs has voiced longstanding objections to NCAs and takes the position that covenants-not-to-compete "restrict competition, disrupt continuity of care, and potentially deprive the public of medical services." For these reasons, the council generally discourages their use, and specifically deems them as unethical if they are excessive in geographic scope or duration or if they fail to reasonably accommodate patients' choices of physicians (AMA 1998.)

[25] See Lowry 2003.
[26] Sorrel, AL (2008). For other anecdotal examples see Ligos (2000) or Wilson (2006).
[27] See for example Di Dio (1999), Kinney (2008), and Whyte (1961)

Recently, NCAs have also emerged as important issue in connection the Patient Protection and Accountable Care Act of 2010, which has sought to promote more integrated patient care through Accountable Care Organizations (ACOs) establishing physician networks. Guidelines for ACOs developed by the Department of Justice and the Federal Trade Commission express antitrust concerns about the creation of these networks if they are accompanied by exclusive contracting.[28] Echoing these concerns, the American Academy of Family Physicians recently took the position that: "non-compete covenants... may bar the employed physician from participating in other ACOs.... Since primary care is in such short supply, the prohibition on participating in an ACO will limit access by patients... The AAFP has recommended legislation prohibiting a single ACO "lock in" for employed physicians."[29]

3.3 State Oversight of Non-Compete Agreements

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, under which courts weigh whether firms have a legitimate protectable business interest in using NCAs, whether NCAs impose an undue burden on workers, and whether they have effects that are contrary to the public interest. The remaining eleven states[30] have passed specific legislation that guides the enforcement on NCAs. Of these 11 states, CO, DE, MA, TN, and TX have laws that expressly prohibit NCAs among physicians, citing the public interest as a primary concern.

The major focus that courts have taken in assessing whether a practice has a legitimate business interest in the context of service firms is in considering investments in developing a client or patient base from protecting these investments from competition by departing physicians. Courts recognize business assets such as confidential client lists as protectable. Arguing that markets for medical services are typically local, it is not uncommon for courts to deem NCAs overly restrictive if they are believed excessive in geographic scope.[31]

Controversy over physician NCAs at the state level not only has a long history, but is ongoing. 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.[32] This prompted the state legislature to enact a bill in 2008 that specifically permitted NCAs for physicians other than emergency physicians and radiologists, and as of 2011 further modifications of the statutes are

[28] FTC and DOJ Final Statement of Antitrust Policy Enforcement Regarding Accountable Care Organizations, Oct. 20, 2011. http://www.ftc.gov/os/fedreg/2011/10/111020aco.pdf

[29] See AAFP 2011.

[30] AL, CA, CO, DE, FL, LA, MA, MT, ND, OK, and TX

[31] See Filipp 2009.

[32] Murfreesboro Medical Clinic, PA v. Udom, 166 S.W.3d 674 (Tenn. 2005)

under discussion.[33]

Variation in the ability to enforce NCAs across states offers an opportunity for comparative analysis. However, an important issue is how 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), those where they are judged "enforceable" (36 states) and those where case law is judged uncertain (9).

While this categorization has the appeal of being easy to apply, in practice issues of enforcement are much more nuanced then these summaries suggest.[34] Recently, a much more careful and precise dataset has been developed and used by Bishara (2011). Based on review of legislation and the case law in each state, Bishara scores the overall ability to enforce NCAs on a state-by-state basis along a total of eight different dimensions. Table 2 reports the questions and rules used in developing these data.

3.4 Data

3.4.1 Physician Survey

This research draws on data from the Physician Perspectives on Managed Care Survey, conducted in 2007 and funded by the Agency for Healthcare Research and Quality (AHRQ), the California Endowment, and the Commonwealth Fund. The study sampled physicians who were listed in the American Medical Association (AMA) Masterfile as providing patient care in the specialties of general family practice, general practice, general internal medicine, and general pediatrics in five states, California, Texas, Illinois, Georgia, and Pennsylvania, which were selected to be representative of a variety of practice environments. Using a state-based sample rather than a national survey permitted collection of larger samples for local market areas. Excluded from the target population were residents, fellows, physicians not in clinical practice, and those over 70 years of age. Pediatricians and minority physicians were over-sampled.[35]

The AMA database provides information on physician location and contact information, specialty and training, age, and, where information was available, 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

[33] See McCreary 2011.

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

[35] While pediatricians made up approximately 23% of the population of eligible physicians in the study states, they were over-sampled so that they made up 45% of the sample. Minority physicians were over-sampled to ensure a sample of at least 200 responses in order to provide a meaningful basis for analyses examining this subgroup.

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%. Responses varied by sampled specialty from 76% for pediatricians to 64% for specialists in internal medicine. 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 on race.

The survey questionnaire included questions on the following topics: physician characteristics, practice characteristics, physician demographics, practice revenues, physician income, administrative controls, practice use of electronic medical records and HIT, and patient vignettes.

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 non-competes: "Were you to leave your (main) practice, would you be subject to a non-compete clause?" Physicians were also asked the year in which they began work in their main practice, from which we have information about practice tenure.

3.4.2 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 Table 2. For example, one important dimension upon which state laws differ is whether NCAs are still enforceable in the even that the employer makes the decision to terminate the relationship. In some states NCAs would still be enforceable, while in others they apply only to voluntary separations made by workers.

In the raw data, the highest score, corresponding the most strictly enforceable NCA laws, was Florida, with a score of 470 points. We normalize the scores as a continuous measure between 0 and 1 by dividing all scores by the maximum score observed. Table 1 shows the ratings from Bishara (2011) for the 5 states in our sample, California, Illinois, Georgia, Pennsylvania and Texas. Bishara (2011) ranks these states respectively as 50th, 4th, 43rd, 23rd, and 32nd in strength of enforcement. As shown in the table, the quantified ratings range from 31 in California to 430 in Illinois, providing substantial variation across states within our sample. We provide more details on the relationships between state NCA laws and other state-level policies that are likely to be correlated with voters' political preferences in Section 5.7.2 and Figure 6.

4 Empirical Methodology

4.1 Determinants of NCA Usage

The first part of the analysis estimates the determinants of NCA usage. We model the simultaneous decisions to work in a group practice or solo practice and whether to accept an NCA conditional on joining a group practice using a bivariate probit model that accounts for sample selection. The selection equation for entering a group practice or hospital (as opposed to a solo practice) is a probit model:

$$g_i = z_i\gamma + u_i$$

where g_i equals 1 if physician i chooses a group practice and z_i is a vector of physician and market characteristics that affect this decision, 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). The selection equation includes a geographic index of the overhead costs associated with running a physician practice in different markets, 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.

Other characteristics in both z_i and x_i include: age, specialty, whether the physician plans to retire within 3 years, a control for US medical training, race, and ownership status. To a limited extent we control for preferences for mobility by including a variable that equals one if the physician has an

employed spouse or partner, which may affect the cost of geographic mobility.[36] We also control for practice and local market conditions, including whether the practice is office-based, free-standing, or associated with a University; whether it is a small practice with 3 or fewer physicians; whether there are physicians with different specialties at the practice; and the log of median household income in the market. In some models we control for the state in which the practice is located to account for differences across states in the strength of non-compete enforcement, and an interaction between state and ownership status. The interaction terms capture possible state-level differences in the treatment of part-owners versus employees. State effects may capture both differences in NCA laws and other unobserved state characteristics. An alternative specification uses the Bishara measure of NCA enforceability.

4.2 Earnings Growth and Returns to Tenure

A key objective of the analysis is to learn about the specific ways in which NCAs affect incentives and the mechanisms by which these incentives affect labor market outcomes. Figures 1 and 2 show that hourly earnings rise substantially more quickly as a function of both experience and tenure for workers with NCAs relative to those without. Isolating the effects of NCAs on the returns to tenure separately from their effects on returns to experience can provide information about the underlying mechanisms that are affected by NCAs. If the rise in earnings is primarily due to tenure at firms that use NCAs, this suggests that incentives to provide firm-specific training or increase the efficiency of client allocation through the legal assignment of property rights are likely to be important factors connected the use of NCAs, and that building relationships with clients leads to increases in earnings over time that are lost if the relationships are terminated through job separations.

There are also other factors that could affect the returns to tenure and experience. As suggested in the theoretical discussion, the interaction of NCAs with labor market inefficiencies due to information asymmetries, unpriced productive efficiencies, search frictions and transaction costs, and latent preference for mobility should tend to increase either the level of earnings, the slope of the earnings profile, or both. Counteracting these effects is the increase in the bargaining power of the firm caused by an NCA, which we expect to have the effects of flattening wage profile.

The basic model of interest is:

$$Y_{ij} = \alpha + x_i\beta_1 + e_i\beta_2 + e_i NCA_{ij}\beta_3 + T_{ij}\beta_4 + T_{ij}NCA_{ij}\beta_5 + NCA_{ij}\beta_6 + \varepsilon_{ij} \tag{3}$$

where the earnings of physician i at firm j, Y_{ij}, depends on observable characteristics of the worker and firm, x_i, the (potential) experience of worker i, e_i, measured in the data as the number of years since graduating from medical school, and the tenure of worker i at firm j, T_{ij}, and the returns to

[36] We also tested controls for geographic differences in average mobility preferences using census data to estimate the probability that a person in a given zip code will move to another zip code more than 100 miles away in a given year. This variable had little explanatory power and was dropped from the analysis.

experience and tenure may depend on whether the worker has an NCA. The well-known concerns with estimating the returns to general experience and firm tenure are that job search or matching cause the error term to be correlated with e_i and/or T_{ij}. Specifically, if the error term in a similar wage model with time variation were decomposed as

$$\varepsilon_{ijt} = \mu_i + \phi_{j(t)} + u_{ijt}$$

where μ_i is a worker effect and $\phi_{j(t)}$ is a firm error component, which could include static firm effects as well as effects on the wage profile, and u_{ijt} is a statistical residual, one concern is that $\phi_{j(t)}$ and T_{ij} may be positively correlated if workers tend to stay in high wage jobs. 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 $\phi_{j(t)}$, causing the net bias to be ambiguous. Topel (1991) describes an auxiliary regression similar to:

$$\phi_{j(t)} = e_i b_2 + e_i NCA_{ij} b_3 + T_{ij} b_4 + T_{ij} NCA_{ij} b_5 + \nu_{ijt} \tag{4}$$

That is, experience provides more time over which matching can occur, inducing a correlation with $\phi_{j(t)}$, tenure may depend on unobserved firm productivity, and NCAs can interact with both effects by altering mobility and/or unobserved productivity.

We first estimate the effect of NCA use on total earnings growth using within-job variation in earnings. For each worker in the sample we have data on up to three years of annual earnings, spread out over a five year window. For workers with NCAs, taking differences in earnings within job identifies:

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

We write NCA_{ij} explicitly in the difference equation since we will consider both binary and continuous measures of enforceability. 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 identified by $\widehat{(\beta_3 + \beta_5)} NCA_{ij}$.

To separately identify the effects of NCA use on returns to tenure, β_5, and returns to experience, β_3, we estimate a two-step model that is a modified version of the model proposed by Topel (1991). The first step is the within-job earnings growth model above, and the second-step is:

$$Y_{ij} = e_{0i}\beta_2 + e_{0i}\beta_3 NCA_{ij} + T_{ij} B_4 + T_{ij} NCA_{ij} B_5 + \xi_{ij} \tag{5}$$

where e_{0i} is the prior experience of worker i at the beginning of the job spell, $B_4 \equiv (\beta_2 + \beta_4)$ and

$B_5 \equiv (\beta_3 + \beta_5)$. Taking first differences of the within-job earnings growth and (5) gives

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

where

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

This provides unbiased estimators $\widehat{\beta_3}$ and $\widehat{\beta_5} = \widehat{B_5} - \widehat{\beta_3}$ under the assumption $\mathbb{E}[e_{0i}\xi_{ij}] = 0$. We test this assumption empirically in our data and estimate the bias caused by correlation between e_{0i} and ξ_{ij}. As reported in Table 12, we fail to reject the assumption, and estimate the empirical bias to be more than 100 times smaller than the baseline estimate of within-job earnings growth associated with NCAs.

4.3 Mobility Models

As suggested by the theoretical model, NCAs have the potential to increase the length of job spells in three ways. 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, and 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, the net effect of NCAs on the duration of job spells is identified. To the extent that hiring is costly for firms, the net effect of NCA use on job-spell lengths is the appropriate measure for estimating the mobility component of the benefit to the firm of using NCAs.

Since a single cross-sectional sample provides limited information for duration analyses, we augment our survey data with the sample of physicians included in CPS data to estimate the flow rate of physicians into jobs over time, $p_g(t)$, by geographic market g. From the physician survey, we have data on the density of elapsed job-spell durations s at the point of time of the survey, for physicians with and without NCAs, which we denote by $h_N(s)$ and $h_C(s)$, respectively. What remains is to estimate the distributions of completed job-spell durations $F_N(s;\theta_N)$ and $F_C(s;\theta_C)$, where θ_N is a vector of parameters that could allow for covariates to affect job-spell lengths. The probability that a worker who began a job at date t is still employed at the same job at time T is $1 - F(T-t;\theta)$. The model of interest is:

$$h_N(s,T) = \frac{p_g(t)\left[1 - F_N(s;\theta_N)\right]}{\int_{-\infty}^{T} p_g(u)\left[1 - F_N(T-u;\theta_N)\right] du} + \varepsilon$$

and similarly for $h_C(s,T)$, where $\varepsilon \sim \mathcal{N}(0, \sigma^2 I)$ is classical measurement error in reported tenure in the physician survey. Note that if the fraction of new jobs in each period that have NCAs is not time-varying, then h does not depend on this fraction. $F_N(s;\theta_N)$ can be estimated by maximizing

the log-likelihood function:

$$L(\theta_N, \sigma_N^2) = \sum_{i=1}^{N_N} \left(-\frac{1}{2}\ln(2\pi\sigma^2) - \frac{1}{2\sigma^2}\left(h_N(s,T) - \frac{p_g(t)\left[1 - F_N(s;\theta_N)\right]}{\int_{-\infty}^{T} p_g(u)\left[1 - F_N(T-u;\theta_N)\right] du} \right)^2 \right)$$

As is generally the case when estimating duration models with data limited to one cross-section, identification required the assumption that the distribution F is stationary over time.

5 Results

5.1 Variation in the Use of NCAs

Since there has been no prior empirical analysis of the use of NCAs in service firms, we begin by documenting their use. Table 3 reports the share of physicians with employment contracts that contain NCAs in each state in our sample. The use of non-compete agreements 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 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.

NCAs are also used more frequently for 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. From a property rights perspective, the benefit to the firm of imposing an NCA on a partner is scaled down by factor of one minus the partner's share. To the extent that turnover is costly for firms, the illiquidity of equity investments in physician practices is also likely to lengthen job spells of owners. We find evidence consistent with this hypothesis in Table **??**. All of these reasons suggest that the net benefit to a firm of imposing an NCA on a part-owner may be lower.[37]

There is some evidence that the use of non-compete agreements may have increased slightly over time. The last column of Table 4 shows that for employee physicians who graduated medical school within 7 years of the survey, about 51.4% were subject to NCAs, compared to about 45%-49% of physicians who graduated between 1978 and 1998.[38]

These changes could also be due to shifts in the characteristics of physician practice patterns over time. Table 5 shows how physician, practice, and market characteristics affect the probability that

[37] Note that states also differ in their legal treatment of the enforceability of NCAs on employees versus owners. This is one reason why the relative proportions of employees and part-owners with NCAs varies across states. For example, in CA and IL, part-owners are slightly *more* likely than employees to be bound by NCAs.

[38] We do not know the exact percentage of new jobs each year that imposed NCAs. Information provided by comparing the share of workers with NCAs across medical school cohorts may be limited to the extent that more experienced workers may have learned to avoid jobs with NCAs. There is some evidence that this may be the case, as experienced physicians with low job tenure were slightly less likely to have NCAs (about 42%).

a physician is subject to an NCA. The results shown are marginal effects of characteristics on the probability of having an NCA conditional on selection into an group practice. The selection equation, which is not reported, is estimated jointly using a bivariate probit that accounts for selection due to incidental truncation. An LR test rejects the null hypothesis that selection into group practices does not bias the estimated marginal effects in all reported models.

We find that practice settings have a large role in determining NCA use: 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 significantly less likely to have NCAs. Ownership status also plays a role: part owners are about 11 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. This coefficient is difficult to interpret, as there could be several opposing possibilities. One is that observable signals of geographic stability are substitutes for NCAs. Another possibility is that the physician's spouse is more likely to be employed if the physician does not have an NCA because earnings are lower, as we will show. In Model 3 we include the Bishara NCA enforceability index and remove state effects. The index is strongly predictive: an 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.[39] 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 5, range from 0.01 to 0.09 in the three models shown.

5.2 Compensation Structures

The first test of the theoretical model presented in Section 2.1 relates to the dynamic changes in the relative bargaining power of workers caused by agreeing to an NCA. In an industry with costly turnover, the model suggests that workers with NCAs will use linear share contracts. Committing to a share contract provides assurance to the worker that earnings will rise in the future commensurate with increases in output without the need to renegotiate contract terms, and protects the firm against committing to a guaranteed future earnings contract before observing worker ability, and potentially causing moral hazard. The model suggests that workers with NCAs should have compensation contracts that are more strongly linked to individual output. For physicians, individual revenue generated is relatively straightforward to calculate.

Table 4 shows summary statistics from a breakdown of each physician's total earnings by source. Physicians with NCAs receive only about 59% of their total income as a guaranteed fixed salary, compared to 74% of income for physicians without NCAs. The variable earnings component due

[39] 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.

to individual workers' output is measured by responses to the question: "What percent of your [annual] earnings was based directly on fees-for-services you provided, or your own productivity?" The share of total earnings that comes from individual productivity is more that twice as high for physicians with NCAs, 27.1% compared to 13.0%. The disparity in the *level* of individual incentive payments in even larger, since physicians with NCAs earn more on average, which we discuss below. Other incentive payments tend in the same direction, accounting for about 7.4% of total earnings for physicians with NCAs and 4.6% for physicians without. Data about these payments are based on responses to the question: "What percent of your [annual] earnings was in the form of pay-outs from practice withholds, practice bonuses, or other incentive payments, including pay-for-performance bonuses?"

Firm size can also affect compensation structures when workers are risk-averse. Redistribution of earnings across workers can provide insurance against worker-level income shocks, but the size of the redistributed share falls as a percentage of income as the size of the firm grows, holding constant the expected variance of earnings. Table 7 shows the percentage of physicians with NCAs by firm size. Among employees, the percentage generally falls with firm size, suggesting that insurance against earnings risk cannot explain the differences in compensation structures, and may attenuate the true difference.

5.3 Patient Allocation and Productivity

Table 8 shows the mean number of weekly patient visits for employees and practice owners with and without NCAs. Employed physicians with NCAs see over 12% more patients per week than those without NCAs, while the number of patients seen by practice owners does not vary much with NCA use. However, 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 significantly more privately insured patients and Medicare patients, who have the high reimbursement rates, while seeing fewer uninsured patients and patients covered by Medicaid. Medicaid payment rates averaged roughly half of the private insurance rate in our data.

Next, we estimate the weekly revenue generated by each physician using data on the number of patients served, the shares of patients that are covered by private insurance, Medicare, Medicaid, and who are uninsured, and the average reimbursement prices for each type of patient. 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 at the time of service for primary care services to new patients making initial visits who are insured by Medicare or Medicaid.[40] Although this estimated revenue index cannot account

[40]Medicare rates are based on HCPCS service code 99203, which provides an approximately 30-minute face-to-face visit by a new patient. This billing code requires 3 components: a detailed medical history, a detailed physical

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.

Both higher levels and more favorable patient mixes increase the estimated weekly revenue generated by physicians with NCAs. The mean estimated weekly revenue is $8,975, about 41.5% higher than the revenue of physicians without NCAs. With only about 10% more hours worked per week, physicians with NCAs are also significantly more productive, generated an average of $229.50 per hour compared to $180.10 for employed physicians without NCAs.

These patterns of patient visit mixes and productivity improvements suggest two points. First, employed physicians with NCAs see both more patients overall and a more valuable mix of patients than do physicians without, consistent with predictions based on the model of property right allocations described in Section 2.1. The second point is that although we find productivity gains associated with the use of NCAs, it is not clear that these gains occur because relationship-assets are allocated differently than they otherwise would have been. Both owners and employed physicians in firms with NCAs have a more profitable mix of patients. This is a key dimension upon which one should expect selection into NCAs to occur: firms that have the most valuable assets that are capable of being protected by NCAs are the most likely to impose NCAs. In addition to having a more valuable overall mix of clients, firms with NCAs distribute the clients more evenly because they retain ownership of property rights.

In Table 9 we look for observable characteristics of physicians or of firms, as well as unobserved characteristics of markets, than might explain the higher levels of productivity observed with the use of NCAs. In Model 1 we find that conditional on observed worker and firm characteristics, the use of NCAs by employees is associated with a significant $145 per hour increase in productivity. Model 2 adds unobserved primary care market effects, and the mean estimate of the effect of NCAs on employee productivity increases further, although the standard errors also become too large for statistical inference. This leaves a few possible explanations. First, practices may differ in productivity for unobservable reasons that are correlated with the value of assets and the net gains from imposing NCAs. And/or second, consistent with the theoretical model, firms that use NCAs have more valuable patients because they have successfully prevented workers from poaching clients in the past.

5.4 Earnings Growth and Returns to Tenure

The theory of compensating wage differentials suggests that earnings levels should be higher for workers with NCAs, who accept restrictions on their occupational choice sets. Of course, firms are only willing to pay a wage differential if they benefit sufficiently from the use of NCAs. Overcoming

examination, and medical decision-making of at least low complexity. Medicaid reimbursement rates are average rates for a primary care service visit by state, based on survey data from physicians reported in Zuckerman et al (2009).

investment holdups by assigning property rights with NCAs, leading to higher productivity, creates rents than can be shared between workers and firms. Table 10 presents estimates of fixed effects models the wage premium associated with the use of NCAs. Model 1 suggests that the hourly earnings of workers with NCAs in their contracts are about 14% higher, conditional on observed worker and firm characteristics and unobserved market effects. Other significant estimates in the model are consistent with theory as well: part-owners and pediatric specialists earn significantly more per hour.

Model 2 includes a continuous measure of NCAs that accounts for variation in state enforceability interacted with the binary NCA indicator. This model suggests that having an NCA in a state with most enforceable laws is associated with a 18.6% hourly earnings premium relative to either not having an NCA or having an unenforceable NCA (the continuous measure treats these as equivalent in theory, but in practice there is a discrete jump associated with having an NCA since the lowest enforceability measure in our data is 0.06 in CA.) A higher earnings premium in states where NCAs are more enforceable is also consistent with theory. If firms are unsure whether an NCA they have imposed will be enforceable, they may temper their investments in workers. This could lead to an equilibrium somewhere between that with perfectly enforceable NCAs and that without NCAs. In addition, Section 5.1 discusses how the use of NCAs by firms increases with their enforceability in a state. If workers have heterogeneous preferences for occupational mobility within their geographic labor market, theory suggests they will sort into jobs with NCAs according to these preferences, and the equilibrium wage differential will be 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. We interpret the estimates in Model 9 as evidence of sorting in NCAs by workers, noting the additional possibility that firms benefit more from NCAs in states with strongly enforceable laws.

Figures 1 and 2 show how hourly earnings grow over time with changes in potential experience and job tenure, conditional on observed worker, firm and market characteristics included in Model 1 in Table 11. As shown in the figures, hourly earnings of workers with NCAs begin around the same level as workers without NCAs, but they rise over time at a much faster rate. After about 20 years of either potential experience or job tenure, hourly earnings of workers with NCAs are about 25 log points higher than observably similar workers without NCAs, consistent with the predictions of the model in Section 2.1.

Additional information about the ways in which NCAs affect incentives within the firm can learned by decomposing within-job earnings growth into components due to experience and tenure separately. Using the two-step approach, described in Section 4.2, to estimating the returns to experience and tenure, Table 12 presents estimates of the first step: total within-job earnings growth. The model estimated is a fixed effects model with job match effects using up to three years of earnings data per physician, from 2002, 2005, and 2006. Model 3 is the main model that we focus on, and main

effects estimates from this model imply that total within-job earnings growth is indistinguishable from zero for physicians without NCAs (a mean estimate of 1% per year with a standard error of 4%). However, within-job earnings growth for physicians with NCAs is substantially higher at 22% per year.

Table 13 presents the remaining estimates of the two-step model. The second-step model suggest that returns to experience associated with NCAs are about 9.8% per year, which implies a lower-bound estimate of the returns to tenure of 12.0%, compared to just 1.6% for workers without NCAs. The estimated bias induced by correlation between e_{0i} and ξ_{ij} is very small, 0.002. These estimates provide evidence that firms that use NCAs invest in their workers in ways that improve both general human capital as well as firm-specific capital, such as client referrals. The total earnings growth comes slightly more from firm-specific investments. The estimates also reveal an interesting point: although prior experience does not appear to be valued by firms that do not use NCAs, experience is valued by firms with NCAs. We discuss this point further in Section 5.7, where we present evidence that firms with NCAs do not appear to differentially select workers with more prior experience. This suggests the difference is truly caused by differences in the returns to experience at firms with NCAs rather than positive selection.

Our results on the effects of NCAs on earnings growth differ from those in Garmaise (2011), which uses data from Execucomp on executives from large publicly-traded US companies, and finds that NCAs are associated with lower average total compensation, and that stronger state-level enforceability of NCAs shifts the composition of earnings away from stock options and towards salaried earnings. One explanation for the differences is that the motivation for using NCAs outside of service firms is very different from the their use in controlling relationship-assets. In particular, we examine the market for services in which information asymmetries are strong, and reputation drives transactions. The relative abilities of workers, as opposed to firms, in overcoming these information asymmetries can affect which agent is better suited for making investments, which could lead to different results outside of service firms.

5.5 Labor Supply

Although our theoretical model discussed the labor supply decision in terms of labor-augmenting effort, the intuition applies generally to labor supply. The result that linear contracts with higher share ratios lead to a larger supply of labor by reducing moral hazard has been shown both theoretically (see Cheung 1968 and Stiglitz 1974) and empirically (see Braido 2008). There are of course many other factors that are connected to the use of NCAs that could affect hours worked. To the extent that the availability of patients is a constraining factor in labor supply decisions for employees, physicians with NCAs (who have more patients, as we have shown) are likely to work more as a consequence of differences in the client allocation problem. Conversely, physicians who are part-owners of a practice are likely work fewer hours as they allocate more of the firm's patients

to employees. In addition, differences in hourly earnings could affect labor supply. The theoretical direction of this effect is ambiguous, but a review of the literature on the uncompensated elasticity of labor supply of US physicians by Nicholson and Propper (2012) suggests the empirical elasticity is close to zero. In the absence of a wage-driven response (in particular, an uncompensated elasticity of supply that is negative enough to overcome both of the other effects), we expect physicians with NCAs to work more hours than those without.

Table 14 compares the unconditional number of hours worked by physicians with and without NCAs by ownership status. Employed physicians with NCAs work about 220 hours more annually, while equity-holding physicians in firms that use NCAs work about 123 hours fewer, both significant differences. Table 15 shows conditional estimates of annual hours worked, controlling for physician and practice characteristics and for unobserved market effects. Model 1 shows that owner-physicians with NCAs work significantly fewer hours, about 207 annually, than comparable physicians without NCAs. Employed physicians work slightly more hours, although the difference is not statistically significant. The net effect is that the distribution of hours worked by ownership status within firms that use NCAs is far more even than in firms without NCAs. Model 2 includes continuous measures of NCAs by interacting with the measure of state enforceability. The qualitative results are similar to those of Model 1, but the estimates suggest that the effects of NCAs on hours worked are stronger where NCAs are more enforceable. Model 3 adds log annual earnings, and again finds similar results. Model 4 includes the incentive share percentage of each physician, measured as the fraction of total earnings that come from incentive payments for individual output. The insignificant and relatively small coefficient (the variable is measured from zero to one) suggests that moral hazard due to the structure of share contracts has negligible effects on hours worked. This finding is consistent with the focus of our theoretical model on the use of share contracts as a mechanism for mitigating the effects of NCAs on dynamic bargaining power rather than reducing moral hazard. It is also possible that labor contracts could contractually specify the number of hours worked, in which case moral hazard should not affect the hours dimension of labor supply, or that the number of hours worked could simply be determined by patient allocations, again limiting moral hazard.

5.6 Mobility

The use of NCAs could be related to the length of job spells for at least two reasons: NCAs could causally lengthen job spells by increasing the cost of mobility, or their use could induce sorting by workers with private knowledge of their own likelihood of switching jobs within a market. Although we cannot identify each effect separately, from the perspective of firms the benefit of reducing hiring costs by longer job spells does not depend on the causality of the effect.

The effects of NCAs on mobility is one topic that has been studied in the empirical literature. Marx, Strumsky, and Fleming (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. And 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.

In Table 16 we show 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 a similar result conditional on observed characteristics. The estimates shown are the differences in the conditional probabilities of observing a given year of tenure for a physician with and without an NCA. Physicians with NCAs were significantly less likely to have tenues between one and seven years, and significantly more likely to have tenure of nine or more years. As shown in Figure 4, the conditional CDF of job tenures of physicians with NCAs first order stochastically dominates the distribution for physicians without NCAs.

Table 17 presents estimates from fixed effects negative binomial models of job tenure, conditional on observed worker and firm conditions and unobserved market effects from the Dartmouth Atlas. Model 1 shows physicians with NCAs have about 29% longer job spells, conditionally. Model 2 shows that the difference in job spell lengths increases with the enforceability of state NCA laws. Although this evidence is not strong enough to conclude causality, it is suggestive that NCAs have some causal effect. The reason for this is because, as shown in Table 5, firms are substantially 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 would be more likely to switch jobs. Model 2 suggests the opposite: where enforceability is higher job spells are longer. Model 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 at all, 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 evidence that each effect separately plays a role in increasing the length of job spells.

5.7 Robustness Checks

5.7.1 Selection on Quality

One potential challenge to interpreting the effects and policy relevance of NCA laws would be if there were systematic selection of high quality workers into jobs with NCAs. If workers with NCAs provide higher quality services than workers without, this could explain the substantially larger rate of within-job earnings growth associated with NCAs. For example, reputation effects could explain why earnings begin at similar levels in early career stages, but diverge over time.

We examine evidence on several direct and indirect measures of quality and find no significant differences between physicians with and without NCAs. First, we compare the prices negotiated

between private commercial insurance plans and physicians. There is substantial variation in negotiated reimbursement rates for standard primary care office visits, which are billed according to fixed amounts of time spent with a physician, even within markets. In our data, the within-market standard deviation in prices, based on Dartmouth Atlas Primary Care Service Area (PCSA) definitions, is $35.49. This suggests that characteristics of physician services are implicitly priced. However, as Table 19 shows, there is no significant difference between the average prices negotiated by physicians with NCAs, $91.14, and those without NCAs, $89.14, for an initial office visit by a private, commercially-insured patient.[41] Table 20 shows results from fixed effects models that regress prices on physician and practice characteristics, with geographic market effects based on county in Model 1 and PCSA in Models 2 and 3. All three models suggest that prices vary by physician 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. Physicians who graduated from US medical schools have been found to perform at lower levels on structural assessments of ability, such as test scores, although there is not a clear pattern of differences in patient outcomes, in part due to the difficulty in measuring quality explicitly.[42] We find that US medical school graduates earn higher prices per visit, by about $15 to $18. The conditional mean prices charged by physicians un university-based practices is also higher, by about $40 to $46, although this difference is not statistically significant. Despite the fact that many characteristics of physicians and their practices are associated with higher prices, we find no significant difference for physicians according to their use of NCAs. The difference in conditional mean prices is also very small, between $1 to $2. This suggests that any difference in quality between physicians with NCAs is not priced by markets, despite evidence that other characteristics are priced as expected.

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 diagnosis and recommended treatments for the patients described in the scenarios. The clinical vignettes and questions were designed by clinical consultants and pre-tested with a clinical panel to ensure that represented a meaningful an accurate assessment 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.[43] We first test for any differences in the responses of physicians with and without NCAs using a chi-square test. As shown in Figure 5, of the 62 chi-square tests for difference in responses to each question, there was only one question to which physicians with NCAs

[41] Negotiated prices are 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?"

[42] See Mick and Comfort (1997) for a review of this literature.

[43] See Veloski et al (2005) for an assessment of vignette-based surveys in measuring physician quality and practice variation.

responded significantly differently (at the 5% level) than physicians without NCAs. We also compare an aggregate measure of compliance with clinical guidelines for a vignette based on the diagnosis and treatment of Asthma.[44] Compliance with Asthma guidelines was tested specifically because it provides a relatively objective assessment of clinical knowledge, whereas expert opinions may differ for other vignettes. As shown in the bottom two rows of Figure 5, we found no statistically significant difference in overall compliance with clinical guidelines among physicians with NCAs. There was, however, considerable potential for measuring variation, as fewer than half of physicians responded in accordance with clinical guidelines.

Third, we test whether physicians that had more experience prior to beginning their current job were more likely to have NCAs. Table 21 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 similar to the ones included in Table 1. We find that experience in prior jobs has no effect, precisely estimated, on the probability of having an NCA.

Collectively, this evidence suggests that any systematic difference in quality among physicians with NCAs would have to be a characteristic that is neither valued by consumers nor insurance companies, is unrelated to clinical knowledge, diagnosis patterns, and treatment recommendations, and is unrelated to experience.

5.7.2 Correlation with Other State Policies

Another concern is whether estimates that are based on differences in the strength of enforceability of NCA laws across states represent true differences in state NCA policies, as opposed to the possibility that NCA laws are dependent indications of broader state-level policies, related perhaps to beliefs about laissez-faire governance or workers' rights that independently affect labor market outcomes across states. We do not believe this concern to be true for several reasons. The controversy surrounding the use of NCAs as potentially restrictive and anti-competitive provisions has existed for hundreds of years, and predates US common law.[45] As common law, the enforceability of NCAs in states has primarily evolved through precedent, much of which was established long before much of the legislation that affects state policies and laws today. In addition, US states differ in both the strength of influence and geography of origin on civil law traditions.

We show empirical evidence that the enforceability of NCA laws is on average uncorrelated with the modern-era political preferences of states. Figure 6 graphs the relationships between the Bishara measure of state enforceability of NCA laws in each state, measured in both 1991 and again in

[44] Specifically, we construct a measure of Asthma Guideline Compliance by comparing responses to guidelines developed by NIH Heart, Lung and Blood Institute and the American Academy of Pediatrics. We define Asthma Guideline Compliance as a binary variable equal to one if three conditions are met. First, the physician diagnosed the patient's condition as persistent moderate asthma (versus mild-intermittent, mild-persistent or severe-persistent). Second, they recommended prescribing inhaled corticosteroids year-round. Third, they would schedule the patient for a follow-up visit with one month. Otherwise, we define Asthma Guideline Compliance to equal zero.

[45] Bishara (2011)

2009, compared to the share of voters in each state that voted for US presidential candidates from the Republican and Democratic parties in the last 5 elections (1992-2008). The expectation is that states that tend to favor pro-business policies and impose fewer regulatory restrictions are likely to favor Republican Party candidates, and also allow businesses to enforce the provisions of labor contracts that are freely agreed-upon by both parties. We find that this is not the case: there is no systematic relationship between the political preferences of voters and state NCA policies. The mean estimate in the graph is slightly negative, the opposite of the predicted direction. We do not mean to suggest that there are no correlations between NCA enforceability and other state laws, but that these correlations, on average, are more likely to be based on common law origins rather than current political preferences.

6 Discussion

Public policies that strongly distort labor markets deserve the intense scrutiny of labor economists. This is especially true of policies that have been handed-down through decades or centuries of tradition, rather than attentive legislation. We present a theoretical model of the impacts of state policies that govern the use of non-compete agreements, which are primarily based on common law traditions, in employment contracts of service workers. Skilled service firms face the unique problem that they do not directly control the rights to what are often their most valuable assets: the loyalty of their customers. Our model shows how NCAs provide a second-best solution of indirect control by breaking the link between producing a service and controlling the associated relationship-asset. In doing so, NCAs distort labor markets in many ways, including altering the bargaining power of firms and increasing the cost of worker mobility, potentially leading to monopsony power in labor markets and market power in output markets. Unlike typical human capital investment decisions, we model the decision whether to make an investment either general or firm specific simultaneously with decisions about a menu of labor market contract options. We show that NCAs can also have positive effects on welfare through the allocation of property rights, and that many of the potentially negative distortions are either offset by endogenous contract responses, such as linear share contracts, or else counteract pre-existing labor market inefficiencies.

Weighing these tradeoffs is ultimately an empirical exercise. We provide the first known empirical evidence on the use of NCAs among service firms, in addition to outlining areas of interest for future research. Using new survey data from primary care physicians, we document the systematic use of NCAs among physician practices, and show that, as a personnel tool, NCAs appear to benefit both workers and firms on average. Consistent with theory, firms that use NCAs have more productive workers, pay workers higher wages, and have substantially higher within-job earnings growth. When earnings growth is decomposed into components, we find that both the returns to tenure and returns to experience are significantly higher in jobs that use NCAs, consistent with increases in both

general and firm-specific human capital. Although NCAs reduce turnover, lengthening job spells, their potentially harmful effects through changes in bargaining power appear to be mitigated, if not eliminated, by the use of linear sharing contracts that are more strongly tied to output in contracts with NCAs. All of these empirical findings hold despite an array of tests that find no evidence of selection on observed or unobserved quality.

Nearly every state permits the use of NCAs, but the economic rationales behind their use are not always transparent and empirical evidence is lacking. Our goal is to articulate the arguments using both theory and empirical analysis. To do so, we draw an important distinction between the use of NCAs by 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 increase earnings growth and investment among service firms. Although further analysis is needed in both settings to assess the total net welfare effects of NCA policies, the findings suggest that decoupling NCA policies across different industries may be beneficial.

Appendices

A A Model of Firm Organization with NCAs

We present a theoretical model of the independencies between the organizational structure of professional service firms, focusing in particular on physician practices, and the incentive to use NCAs. The model builds on theories of partnerships proposed by Ward (1958), Farrell and Scotchmer (1988), and Levin and Tadelis (2005). We then extend this model to allow for competitive entry and exit. Finally, we allow partnerships to endogenously agree to impose NCAs on partners.

There are several reasons why firms have an incentive to impose NCAs. First, NCAs provide some insurance to workers against a partnership unraveling due to entry of a competitor. This incentive does not exist for corporations. Second, if recruiting new workers is costly, NCAs may provide firms with some insurance against workers leaving quickly. Third, NCAs can prevent a worker from stealing clients away from a firm. This insurance could facilitate productivity-increasing investments by the firm that may not otherwise be incentive compatible. Again, there is reason to suspect that this incentive may be stronger for partnerships than for corporations, in which individual productivity gains are more directly internalized.

The decision of organizational form faced by private group-practice physicians[46] is typically quite simple: organize as a corporation or a partnership.[47] The distinguishing features between partnerships and corporations are the extent to which profits are redistributed to workers (as opposed to owners who are not productive workers,) and the uniformity of the redistribution.

There are several explanations why groups of workers may organize as a partnership as opposed to a corporation. Levin and Tadelis (2005) argue that in professional service markets in which the quality of a worker is difficult for clients to observe directly, organizing as a partnership provides a credible signal of firm quality, since redistribution of profits gives partners the incentive to prefer other partners who are relatively productive. Gaynor and Gertler (1995) argue that partnerships have the advantage of diversifying risk due to shocks to individual productivity, but that risk-sharing comes at the cost of moral hazard, which significantly reduces effort among partners.

A.1 Partnership Model

Consider a finite set P of workers whose abilities a are distributed on the support $[\underline{a}, \overline{a}]$ with density $f(\cdot)$. Each worker has an outside labor market option to earn wage $w(a)$.[48] With a set of employed workers A and fixed capital K, a firm can produce a quantity $|A|$ of services, equal to the size of A. The quality of a firm's service equals the average ability of the workers in A:

$$q(A) = \frac{1}{|A|} \int_{\tilde{a} \in A} \tilde{a} f(\tilde{a}) d\tilde{a}$$

[46] By 'private-practice physicians' which we mean to speak of physicians who work in either solo or group practices, and are not employed by hospitals, HMOs, medical schools, or government agencies.

[47] By partnership we mean that the firm redistributes collective profits, and by corporation we mean, more or less, that the firm maximizes aggregate profits and each worker receives their marginal value product of labor. Of course, most firms that fit this definition of a partnership are legally called corporations, but we mean for the distinguishing feature between partnerships and corporations to be the extent of redistribution of profits across workers.

[48] Assume that w is $\mathbb{C}_2$, $w'(a) > 0$, and $w''(a) > 0$

Identical consumers value the firm's services at the expected quality of service. Under perfect information, the market knows that the firm has employed the set of workers A, and clients are willing to pay:

$$p(A) = q(A)$$

However, as is characteristic of the market for healthcare and other specialized high-skill services, there is an information asymmetry between physicians and consumers regarding the quality of physicians. Suppose that with probability μ a client can observe the true quality of a firm, and with probability $1 - \mu$ the client cannot observe the worker's quality, and assumes that the worker has the expected quality of all workers in the firm, denoted $\overline{A_j}$. The expected price per service received by the worker is:

$$\mu p(A) + (1 - \mu)p(\overline{A_j})$$

.

Assume that economies of scale caused by the fixed capital assumption are offset by size inefficiencies, which cost $c(|A|)$, where c is $\mathbb{C}_2$, $c'(|A|) > 0$, $c''(|A|) > 0$. This inefficiency is simply intended to allow the model to capture the relevant characteristics of non-hospital-based physician practices, of which the median size is about 5 physicians. One explanation which is consistent with this model is that consumers are averse to traveling and willingness to pay decreases with distance, creating an potential incentive for several diffuse firms rather than a monopoly. The firm's profit from hiring workers A is then:

$$\Pi(A) = \int_{a \in A} [\mu p(A) + (1 - \mu)p(\overline{A_j}) - w(a)]f(a)da - K - c(|A|) \tag{1}$$

Assume that $\exists A : \Pi(A) > 0$ and $\Pi[\underline{a}, \overline{a}] < 0$.

Partnerships are characterized by the redistribution of profits across workers. Assume for simplicity that all partners receive equal shares, although this assumption will be relaxed somewhat later. Each partner receives a share equal to:

$$s(A, \overline{A_j}) = \mu p(A) + (1 - \mu)p(\overline{A_j}) - \frac{K + c(|A|)}{|A|} \tag{2}$$

.

The opportunity cost to a worker of receiving s is $w(a)$, so the incentive compatibility constraint for worker a to join a partnership with subsequent group A is that $s(A, \overline{A_j}) \geq w(a)$.

DEFINITION 1: A *stable partnership* is a group A such that:
1: $s(A, \overline{A_j}) \geq w(a) \; \forall \; a \in A$ and
2: There does not exist a worker a_1 in partnership A and a worker a_2 outside of partnership A such that the partnership can benefit by replacing a_1 with a_2, who is willing to join.

For a general class of models with coalitions, such as this, the following theorem due to Farrell and Scotchmer (1988) holds.

THEOREM 1 (FARRELL AND SCOTCHMER 1988): Let N be a finite set of agents. Suppose that there is a function u(A) that describes every agent's ranking of coalitions that contain him or her. Then:

1: There is a partition of the players into coalitions such that no new coalition could form and make all its members strictly better off; and

2: that partition is generically unique.

The proof of this theorem has a relevant implication that the equilibrium is characterized by consecutive groups of workers, each of which is a closed convex subset of $[\underline{a}, \overline{a}]$. This implies that groups can be strictly ranked by ability. The logic is that in partnerships each worker wants to join with the most able group of workers possible. There is a coalition A_1 that first maximizes $u(\cdot)$ and contains the highest ability workers. Since $\Pi[\underline{a}, \overline{a}] < 0$ there will be remaining workers once this group forms. From that point one can repeat the same logic with the remaining workers. Eventually one will reach a situation in which every remaining worker will join together as a partnership or will all prefer the outside option, $w(a)$.

At each step in the sequence the identity of the highest ability worker remaining without a partnership is not affected by any decision of workers who are not in partnerships. Denote the exogenously-determined ability of the highest ability remaining worker when firm j is formed by $\overline{a_j}$. We can then write the objective function of an arbitrary potential partnership j as:

$$\max_{a \in [\underline{a}, \overline{a_j}]} s(a, \overline{A_j}) = \mu p(a) + (1-\mu) p(\overline{A_j}) - \frac{K - c(F(\overline{a_j}) - F(a))}{F(\overline{a_j}) - F(a)} \tag{3}$$

subject to the stability constraint.

A.2 Free-Entry Equlibrium

We consider a simple model of sequential entry, and then aggregate the effects to model unconstrained entry. The simplification is that we do not consider simultaneous entry of multiple agents. The model is generalizable to situations in which the entry of a new firm requires at least some hiring of workers away from incumbent firms in the local labor market.

In each period a single worker receives a random draw $\tilde{a}$ from the distribution $f(\cdot)$ and decides whether to enter the market. Let $J, J-1, \ldots, 1$ be the ranking of firms by ability in descending order.

PROPOSITION 1: An entering worker cannot disturb any partnership with strictly higher ability than j^*, where j^* is the lowest value for which $\underline{a_{j^*}} > \tilde{a}$.

Firm j^* solves the first order condition and hires worker $\tilde{a}$ if:

$$\mu \tilde{a} + (1-\mu) p(\overline{A_j}) \geq \mu p(\tilde{a}) + (1-\mu) p(\overline{A_j}) - \frac{K - c(F(\overline{a_j}) - F(\tilde{a}))}{F(\overline{a_j}) - F(\tilde{a})} \tag{4}$$

That is, firm j^* hires worker $\tilde{a}$ if the marginal product of worker $\tilde{a}$ is at least as large as the average profit share of the partnership conditional on hiring $\tilde{a}$. If this condition holds then firm j^* grows in size by one worker and the rest of the market is unaffected.

PROPOSITION 2: If the hiring condition does not hold for firm j^* and if $j^* > 1$ then the hiring condition must hold for firm $j^* - 1$, and there exists a unique stable partnership which is a subset of $j^* - 1 \cup \tilde{a}$.

Firm $j^* - 1$ then faces the sequential separation problem:

$$\mu \underline{a_{j-1}} + (1-\mu)p(\overline{A_j}) < \mu p(\underline{a_{j-1}}) + (1-\mu)p(\overline{A_j}) - \frac{K - c(F(\overline{a_{j-1}}) - F(\underline{a_{j-1}}))}{F(\overline{a_{j-1}}) - F(\underline{a_{j-1}})} \tag{5}$$

If this condition holds the high ability partners in firm $j^* - 1$ prefer to leave the firm and form a new firm without $\underline{a_{j-1}}$, causing the firm to unravel from the top. This logic can be applied sequentially so that multiple partners can separate with firm $j^* - 1$ as the result of a single new worker entering the market. This process then repeats with firms $j^* - 2, \ldots, 1$.

In this model all workers with quality above some threshold work in partnerships, and below the threshold exit the market and take the outside option. The threshold could be below $\underline{a}$ in which case all physicians stay. In the former case entry of a worker above the threshold can cause the lowest ability worker(s) above $\underline{a}$ to be left without a partnership, in which case they may prefer the outside option.

A.3 Free-Entry with Endogenous Non-Compete Agreements

Suppose that partners are able commit to making pareto-improving side payments to other partners within the firm (but not outside of the firm). Note that this partially relaxes the equal sharing rule. Consider first a firm whose partners have agreed to a non-compete restriction, preventing any partner from switching firms in the market. Then consider the incentive compatibility requirement for the partners of a firm to have come to this agreement.

Consider firm j that has a non-compete agreement. Suppose worker $\tilde{a}$ is considering entering the market, and hiring condition (4) does not hold for partnerships $J, \ldots, j+1$, but does hold for j. Since firm j has a non-compete agreement its high-ability partners cannot leave to form a new partnership even if the separation condition given by (5) fails to hold. Consequently, for firm j to be willing to hire $\tilde{a}$, the hiring condition given by (4) must hold *and* separation condition (5) must not hold. If (5) does not hold then $\tilde{a}$ joins partnership j and the remaining firms are unaffected. With some positive probability (5) will hold, and the dynamic firm may have preferred that the static firm had not accepted worker $\underline{a_j}$, given the possibility that $\tilde{a}$ would enter. Therefore, in the dynamic setting, a partnership that imposes NCAs will be more selective in accepting partners, decreasing the expected firm size, increasing the number of firms, and decreasing heterogeneity in ability within-firm.

If (5) holds then the remaining pool of workers who are eligible to become partners with $\tilde{a}$ are those in firms $j-1, \ldots, 1$. If $j > 1$ and if $j-1$ does not have a non-compete agreement then Proposition 2 applies, otherwise the logic applied to firm j repeats until $\tilde{a}$ either joins a stable partnership or prefers the outside option. A stable partnership containing $\tilde{a}$ need not exist even if workers with ability $a > \tilde{a}$ are in stable partnerships because $w'(a) > 0$. That is, worker $\tilde{a}$ may fall to a lower ranked firm because of the use of non-compete agreements, but may not be willing to fall very far if $w(\tilde{a})$ is sufficiently large.

If a stable partnership containing $\tilde{a}$ exists, the characterization of any equilibrium by firms that are consecutive closed convex subsets of $[\underline{a}, \overline{a}]$ may break down. That is, free entry can change the quality ranking of firms when non-compete agreements are used. More generally, even though quality is important for partnership formation, the use of NCAs (including use by *other* firms in the market) reduces the strength of sorting on quality in the market.

We now turn to the question of why non-compete agreements arise in partnerships in this reputation-based model. Consider a stable partnership facing the possibility of entry. If the entrant has quality above that of the partnership there is some probability that the partnership will unravel, after which the low ability worker(s) will switch to lower partnerships and their earnings s will fall, while the high ability workers will have higher s. If one adds up the expected losses and gains from entry across all workers in the firm, if that sum is negative then there exists a pareto-improving set of transfers from the relatively low ability workers to the relatively high ability workers to prevent the possibility of s falling as a result of entry. NCAs are a credible commitment device that can prevent high ability workers from exiting the firm.

Consider the types of partnerships that might be likely to accept non-compete agreements. NCAs are incentive compatible if the sum of expected losses from lower ability workers in the firm exceed the sum of expected gains of higher ability workers. This could occur, for example, if the distribution of ability within the firm is left-skewed. In a competitive market with many firms, as long as the market distribution of a is sufficiently smooth, the distribution of ability within each firm is approximately uniform, in which case their is clear relationship between ability and the use of NCAs, even though ability is essential to the formation of partnerships. Risk aversion could also contribute to the incentive to accept an NCA, since equal magnitude losses by low ability workers are more costly than gains by high ability workers.

If transfer payments made in exchange for imposing NCAs are based on the share of the firm's earnings, there are several additional predictions that come from this reputation-based model. First, partnerships that use NCAs should have higher within-firm earnings dispersion than partnerships that don't use NCAs. Second, the magnitude of within-firm wage dispersion should increase with market concentration, as the benefits and costs of switching firms are higher if average quality of firms are further apart. Third, since the redistribution associated with NCA use acts like a decrease in the extent of profit redistribution, partnerships with NCAs are slightly more similar to corporations, in which each worker earns their own marginal value product. As shown by Levin and Tadelis (2005), when firm reputation matters, corporations are larger than partnerships. This effect partially offsets the increased selectivity of firms that use NCAs. And fourth, firms with workers that have higher risk aversion are more likely to accept NCAs.

B Survey Vignette Sample

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: _____.

C Bishara Measure of State NCA Enforceability

Table 1: 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 2 for explanation of question numbers.

Table 2: 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).

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7 Tables

Table 3: % of Respondents with NCAs, By State and Employment Status

	Full Sample		Employees		Part Owners	
California	511	31.3%	225	29.8%	206	36.9%
Georgia	120	51.7%	51	60.8%	53	43.4%
Illinois	217	52.1%	124	50.0%	73	54.8%
Pennsylvania	231	60.6%	147	66.0%	62	54.8%
Texas	268	49.6%	129	58.9%	97	45.4%
All States	1347	45.1%	723	49.2%	534	43.1%

Table 4: % of Employees with NCAs, By Potential Experience and Practice Tenure

	Tenure				
Potential Experience	1 to 7	8 to 14	15 to 21	22+	
1 to 7	51.4%				51.4%
8 to 14	37.1%	55.6%			47.0%
15 to 21	41.5%	49.2%	58.0%		49.0%
22+	42.4%	47.1%	47.6%	47.4%	45.6%
	44.1%	53.6%	54.2%	47.4%	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 within the prior 27 years.

Table 5: 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							0.305	***	[0.069]
Office-Based	0.178	***	[0.037]	0.184	***	[0.039]	0.180	***	[0.037]
Free-Standing Practice	−0.215	*	[0.122]	−0.203		[0.125]	−0.214	*	[0.121]
University Practice	−0.184	***	[0.058]	−0.184	***	[0.058]	−0.181	***	[0.059]
Multi-Specialty Practice	0.040		[0.036]	0.037		[0.036]	0.045		[0.035]
Large Practice (25 Plus)	0.027		[0.042]	0.022		[0.044]	0.024		[0.042]
Part Owner	−0.116	***	[0.032]	−0.150		[0.094]	−0.117	***	[0.032]
Independent Contractor	−0.207	***	[0.054]	−0.199	***	[0.056]	−0.208	***	[0.054]
Internal Medicine	0.049		[0.040]	0.052		[0.041]	0.055		[0.040]
Pediatrics	0.054		[0.036]	0.053		[0.036]	0.059	*	[0.035]
Secondary Specialty	0.055		[0.038]	0.055			0.058		[0.038]
Male	0.005		[0.033]	0.006		[0.033]	0.005		[0.033]
Employed Spouse	−0.070	**	[0.031]	−0.068	**	[0.032]	−0.070	**	[0.031]
US Med. School	0.054		[0.046]	0.056		[0.046]	0.057		[0.045]
Log Potential Experience	−0.526		[0.578]	−0.377		[0.477]	−0.516		[0.566]
Log Potential Experience Sq.	0.211		[0.212]	0.154		[0.174]	0.217		[0.208]
Plan to Retire	−0.224	***	[0.085]	−0.209	**	[0.090]	−0.226	***	[0.084]
Median HH Income	−0.096		[0.176]	−0.028		[0.179]	−0.093		[0.169]
Poverty Rate	−0.018	*	[0.010]	−0.017	*	[0.010]	−0.019	**	[0.009]
Unemployment Rate	−0.018		[0.020]	−0.017		[0.021]	−0.020		[0.020]
State PA	0.099		[0.090]	0.109		[0.110]			
State CA	−0.191	***	[0.069]	−0.255	***	[0.088]			
State TX	−0.004		[0.072]	0.043		[0.093]			
State IL	0.073		[0.080]	0.051		[0.104]			
State PA*Part Owner				−0.066		[0.118]			
State CA*Part Owner				0.173		[0.120]			
State TX*Part Owner				−0.075		[0.109]			
State IL*Part Owner				0.059		[0.133]			
Log Likelihood	-1600.68			-1595.26			-1610.02		
Log Likelihood under Null of No Selection Bias	-1604.35			-1597.91			-1611.43		
p-value of LR Test	0.007			0.021			0.093		
N	1676			1676			1676		

Notes: Marginal effects at means reported conditional on selection into a group practice. Selection equations, not reported, include a geographic physician practice cost index (GPCI), and its squared value. GPCI is calculated by the US Government Accounting Office to estimate geographic variation in the cost of operating a private medical practice, and is used to set geographic adjustment factors for 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. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Table 6: NCAs and Compensation Structure

	NCA	No NCA
% Earnings from Flat Salary	58.92%	74.01%
(S.E.)	(2.60%)	(2.33%)
% Earnings from Individual Productivity	27.12%	13.03%
(S.E.)	(2.60%)	(1.88%)
% Earnings from Other Incentive Payments	7.35%	4.59%
(S.E.)	(0.70%)	(0.59%)

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.

Table 7: NCA Use by Firm Size

	All Physicians		Employees Only	Part-Owners
	Mean	N	Mean	Mean
2 to 3 Physicians	31.59%	383	52.44%	15.98%
4 to 6 Physicians	46.57%	350	51.23%	40.14%
7 to 9 Physicians	50.31%	161	51.69%	48.61%
10 to 19 Physicians	50.00%	180	47.71%	53.52%
20 to 99 Physicians	40.12%	167	30.36%	60.00%
100 to 499 Physicians	44.07%	118	42.62%	45.61%
500+ Physicians	7.80%	218	34.15%	1.69%

Notes: Firm sizes include survey respondent. Median size of firm for physicians in non-solo practices with NCAs is 7 and without NCAs is 6. Average size of firms (number of physicians) at which physicians with NCAs work is 26.5, compared to 28.8 for physicians without NCAs, excluding very large firms with more than 500 physicians.

Table 8: Patient Stocks, Revenue, and Productivity

	Employees		Owners	
	Without NCA	With NCA	Without NCA	With NCA
Total Patient Visits (Weekly)	86.5	97.3	111.8	109.5
Privately Insured	44.6	55.0	61.5	78.1
Medicare	12.0	17.2	22.3	14.6
Medicaid	20.6	18.5	20.5	11.6
Uninsured	9.3	6.6	7.5	5.2
Estimated Weekly Revenue Generated	$6,339	$8,975	$8,249	$9,112
Hours of Patient Care per Week	35.2	39.1	42.5	39.0
Productivity (Revenue per Hour)	$180.1	$229.5	$194.1	$233.6

Notes: 'Estimated Weekly Revenue Generated' is computed 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.

Table 9: NCAs and Productivity
Depedent Variable: Revenue Generated per Hour

	(1) OLS		(2) Fixed Effects	
	β	SE	β	SE
NCA	145.18 **	[71.63]	153.99	[163.30]
Owner	16.26	[38.12]	25.07	[102.75]
Owner*NCA	−127.99	[90.45]	−101.19	[192.93]
Office-Based	16.87	[102.98]	65.51	[192.08]
Free-Standing Practice	−125.93	[139.19]	−42.01	[248.86]
University Practice	−166.37 *	[97.61]	−155.52	[188.42]
Multi-Specialty Practice	17.14	[37.05]	−34.45	[70.20]
Independent Contractor	122.74	[148.85]	0.89	[151.15]
Internal Medicine	−105.72 **	[40.95]	−137.37	[110.23]
Pediatrics	−5.73	[47.13]	88.72	[90.14]
Secondary Specialty	18.95	[35.55]	64.74	[95.15]
Male	57.79	[40.50]	63.41	[89.81]
US Med. School	−30.73	[46.81]	−97.39	[123.86]
Potential Experience	1.78	[8.20]	1.63	[16.81]
Potential Experience Sq.	−0.15	[0.20]	−0.24	[0.40]
Job Tenure	4.36	[8.85]	−8.53	[19.44]
Job Tenure Sq.	0.02	[0.26]	0.34	[0.56]
Primary Care Market Effects	No		Yes	
R Sq.	0.04		0.53	
N	521		482	

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 10: Fixed Effects Wage Models
Dependent Variable: Log Hourly Earnings

	(1)			(2)		
	β		SE	β		SE
Non-Compete	0.140	**	[0.062]			
Bishara Score*NCA				0.186	**	[0.092]
Office-Based	−0.074		[0.078]	−0.068		[0.078]
Free-Standing Practice	−0.137		[0.236]	−0.153		[0.238]
University Practice	0.155		[0.157]	0.157		[0.158]
Large Practice (25 Plus)	0.068		[0.074]	0.067		[0.074]
Multi-Specialty Practice	0.049		[0.068]	0.050		[0.068]
Part Owner	0.122	*	[0.063]	0.123	**	[0.062]
Sole Owner	−0.064		[0.094]	−0.082		[0.092]
Independent Contractor	−0.055		[0.138]	−0.065		[0.137]
Internal Medicine	0.056		[0.078]	0.053		[0.079]
Pediatrics	0.070		[0.068]	0.062		[0.068]
Secondary Specialty	0.054		[0.079]	0.049		[0.079]
Plan to Retire	0.282		[0.245]	0.267		[0.248]
Male	0.107	*	[0.063]	0.104	*	[0.062]
US Med. School	−0.036		[0.099]	−0.033		[0.100]
Patients per Week	0.002	***	[0.001]	0.002	***	[0.001]
Years Tenure	0.005		[0.004]	0.005		[0.004]
Potential Exp.	−0.002		[0.005]	−0.002		[0.005]
Primary Care Market Effects	Yes			Yes		
R Sq.	0.508			0.507		
N	900			900		

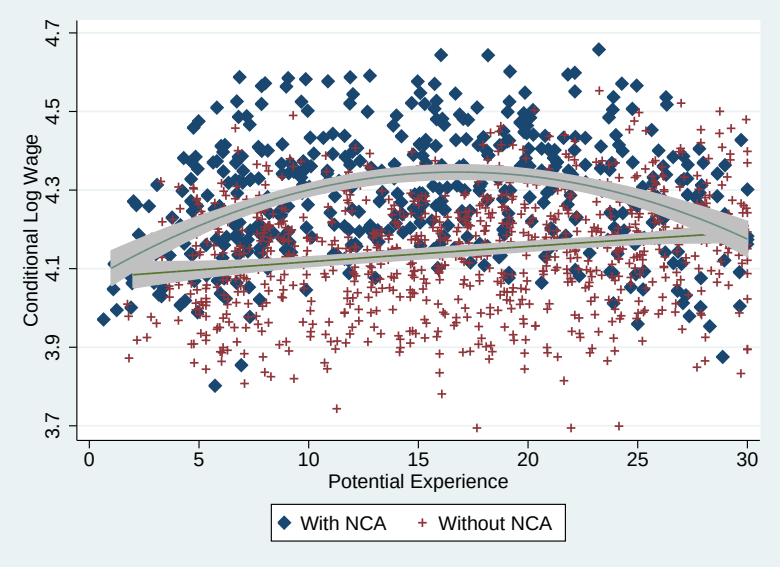
Notes: All models include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care, and physician race indicators. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. White-Huber standard errors in brackets.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

Table 11: Fixed Effects Earnings Profile Models

	(1)			(2)			(3)		
	Dep Var: Log Hourly Earnings						Dep Var: Log Annual Earnings		
	β		SE	β		SE	β		SE
NCA	−1.193	**	[0.592]				−1.002	*	[0.562]
NCA*Log Exp.	1.260	**	[0.500]				1.010	**	[0.471]
NCA*Log Exp. Sq.	−0.272	***	[0.103]				−0.214	**	[0.096]
Bishara Score*NCA				−1.508	**	[0.621]			
Bishara Score*NCA*Log Exp				1.312	**	[0.536]			
Bishara Score*NCA*Log Exp Sq.				−0.239	**	[0.114]			
Log Tenure	0.281	**	[0.132]	0.290	**	[0.131]	0.274	**	[0.117]
Log Tenure Sq.	−0.054		[0.035]	−0.055		[0.035]	−0.051	*	[0.030]
Log Exp.	−0.582		[0.450]	−0.447		[0.370]	−0.437		[0.421]
Log Exp. Sq	0.118		[0.093]	0.078		[0.078]	0.082		[0.087]
Log Annual Hours							0.297	***	[0.071]
Office-Based	−0.077		[0.075]	−0.072		[0.075]	−0.091		[0.065]
Free-Standing Practice	−0.109		[0.229]	−0.126		[0.234]	−0.024		[0.194]
University Practice	0.152		[0.146]	0.160		[0.150]	0.088		[0.097]
Multi-Specialty Practice	0.038		[0.060]	0.033		[0.060]	0.056		[0.053]
Small Practice (1-3)	0.007		[0.064]	0.000		[0.064]	−0.043		[0.057]
Part Owner	0.113	*	[0.061]	0.097		[0.061]	0.156	***	[0.056]
Sole Owner	−0.096		[0.095]	−0.094		[0.093]	−0.048		[0.084]
Independent Contractor	−0.105		[0.144]	−0.114		[0.145]	−0.101		[0.161]
Patients per Week	0.002	***	[0.001]	0.002	***	[0.001]	0.004	***	[0.001]
Internal Medicine	0.070		[0.078]	0.075		[0.078]	0.090		[0.069]
Pediatrics	0.053		[0.068]	0.057		[0.069]	0.006		[0.061]
Secondary Specialty	0.031		[0.080]	0.043		[0.080]	0.097		[0.070]
Male	0.141	**	[0.062]	0.133	**	[0.062]	0.246	***	[0.057]
US Med. School	−0.022		[0.100]	−0.029		[0.101]	0.017		[0.087]
Primary Care Market Effects	Yes			Yes			Yes		
R Sq.	0.521			0.519			0.641		
N	896			896			896		

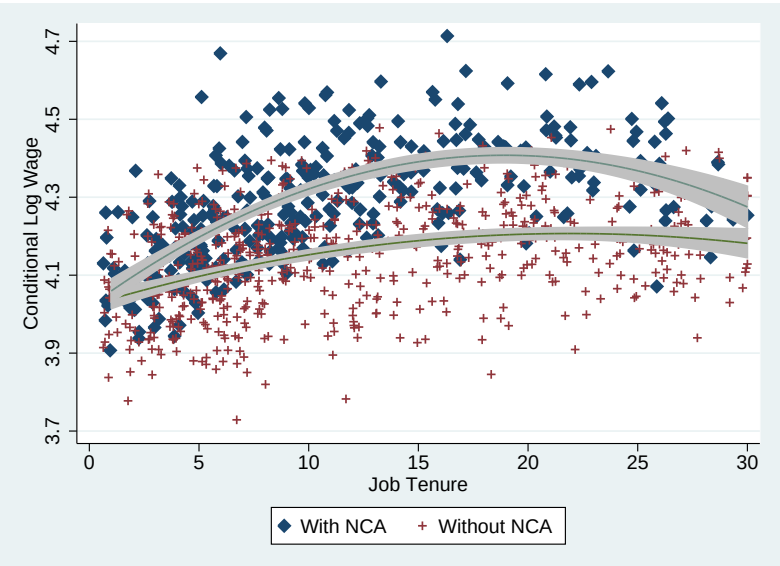
Notes: All models include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care, and physician race indicators. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. White-Huber standard errors in brackets.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

Figure 1: Potential Experience Wage Profile



Notes: Vertical axis is expected hourly earnings conditional on covariates in Model 1 in Table 11 and demeaning Primary Care Market Effects. Sole owners are excluded. Line is best-fitting quadratic function, with 95% confidence interval.

Figure 2: Tenure Wage Profile



Notes: Vertical axis is expected hourly earnings conditional on covariates similar to those in Model 1 in Table 11 except with tenure instead of experience interacted with NCA, and demeaning Primary Care Market Effects. Sole owners are excluded. Line is best-fitting quadratic function, with 95% confidence interval.

Table 12: Fixed Effects Models: Within-Job Earnings Growth

	(1)			(2)			(3)			(4)		
	β		SE	β		SE	β		SE	β		SE
NCA*Job Tenure	0.18	***	[0.06]	0.18	***	[0.06]	0.22	***	[0.07]			
NCA*Job Tenure Sq.				0.00		[0.00]	−0.01	*	[0.01]			
NCA*Job Tenure Cu.							0.00	*	[0.00]			
NCA*Job Tenure 4th							0.00	*	[0.00]			
NCA*BS*Job Tenure										0.23	**	[0.09]
NCA*BS*Job Tenure Sq.										−0.02	*	[0.01]
NCA*BS*Job Tenure Cu.										0.00	*	[0.00]
NCA*BS*Job Tenure 4th										0.00	**	[0.00]
Job Tenure	0.01		[0.03]	0.02		[0.03]	0.01		[0.04]	0.05		[0.03]
Job Tenure Sq.				0.00	**	[0.00]	0.00		[0.00]	0.00		[0.00]
Job Tenure Cu.							0.00		[0.00]	0.00		[0.00]
Job Tenure 4th							0.00		[0.00]	0.00		[0.00]
NCA*Potential Exp. Sq.	−0.03	***	[0.01]	−0.02	***	[0.01]	−0.02	**	[0.01]			
NCA*Potential Exp. Cu.	0.00	***	[0.00]	0.00	***	[0.00]	0.00	**	[0.00]			
NCA*Potential Exp. 4th	0.00	**	[0.00]	0.00	**	[0.00]	0.00	*	[0.00]			
NCA*BS*Potential Exp. Sq.										−0.01		[0.01]
NCA*BS*Potential Exp. Cu.										0.00		[0.00]
NCA*BS*Potential Exp. 4th										0.00		[0.00]
Potential Exp. Sq.	0.00		[0.00]	0.00		[0.00]	0.00		[0.00]	0.00		[0.00]
Potential Exp. Cu.	0.00		[0.00]	0.00		[0.00]	0.00		[0.00]	0.00		[0.00]
Potential Exp. 4th	0.00		[0.00]	0.00		[0.00]	0.00		[0.00]	0.00		[0.00]
Job Match Effects	Yes			Yes			Yes			Yes		
R Sq.	0.96			0.96			0.96			0.96		
N	2255			2255			2255			2255		

Notes: All models include job match effects. Dependent variable is annual earnings, observed in up to three years over a five year window between 2002 and 2006. 'BS' stands for Bishara Score. 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 13: Effects of Experience and Tenure on Real Earnings Growth

	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	-0.005	0.011	0.016	0.001
	(0.003)	(0.036)	(0.034)	(0.003)
	$\underline{\beta_3}$	$\underline{\beta_3 + \beta_5}$	$\underline{\beta_5}$	$\underline{b_3 + b_5}$
Main Effect*NCA	0.098 ***	0.218 ***	0.120 **	0.002
	(0.010)	(0.068)	(0.061)	(0.002)

Notes: Estimate of within-job earnings growth is from Table 12, Model 3. Dependent variable in other models is log annual earnings minus estimated within-job growth effects. The second step model also includes physician specialty, practice setting, ownership status, gender, foreign medical school graduate, race, and firm size variables. Sample includes physicians who reported between 200 and 4000 annual hours worked and are less than 65 years old. Standard errors, reported in parentheses, are White-Huber heteroskedasticity-adjusted and Murphy-Topel adjusted for first-step sampling error. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Table 14: Unconditional Annual Hours Worked by NCA Use

	Employees		Part-Owners	
	NCA	No NCA	NCA	No NCA
Mean Price	2,095	1,875	2,231	2,354
(S.E.)	(45)	(40)	(45)	(43)

Notes: P-value of t-test for employees < 0.001, p-value of t-test for part-owners is 0.049.

Table 15: Fixed Effects Models: Annual Hours Worked

	(1)	(2)	(3)	(4)
NCA	-207.40 **		-348.65 ***	-280.15 **
	[91.54]		[117.07]	[110.01]
Bishara Score*NCA		-457.27 ***		
		[135.33]		
Employee	-371.73 ***	-376.79 ***	-352.16 ***	-405.78 ***
	[91.54]	[81.37]	[130.35]	[116.34]
Employee*NCA	260.56 **		386.23 **	325.83 **
	[125.16]		[171.74]	[159.83]
Employee*Bishara Score*NCA		530.65 ***		
		[171.21]		
Log Earnings			398.52 ***	
			[89.95]	
Incentive %				125.92
				[104.93]
Married	98.40	87.89	165.77	215.79
	[116.60]	[116.25]	[160.63]	[139.48]
Spouse Employed	-214.15 **	-211.34 **	-229.18 **	-279.32 ***
	[83.66]	[83.54]	[109.22]	[101.41]
Children Under 6	-186.08 **	-191.26 **	-271.34 **	-235.92 **
	[90.51]	[89.71]	[120.41]	[112.85]
Primary Care Market Effects	Yes	Yes	Yes	Yes
N	1018	1018	683	824
R Sq.	0.50	0.51	0.62	0.53

Notes: Dependent variable is annual hours worked. All models include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care. All models also control for age, age squared, tenure, tenure squared, gender, physician specialty, practice type, practice size, US medical school graduate indicator, and three race indicators. Sample includes physicians who worked at least 10 hours per week at their main practice and are less than 65 years old. White-Huber heteroskedasticity-adjusted standard errors reported in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Table 16: 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	

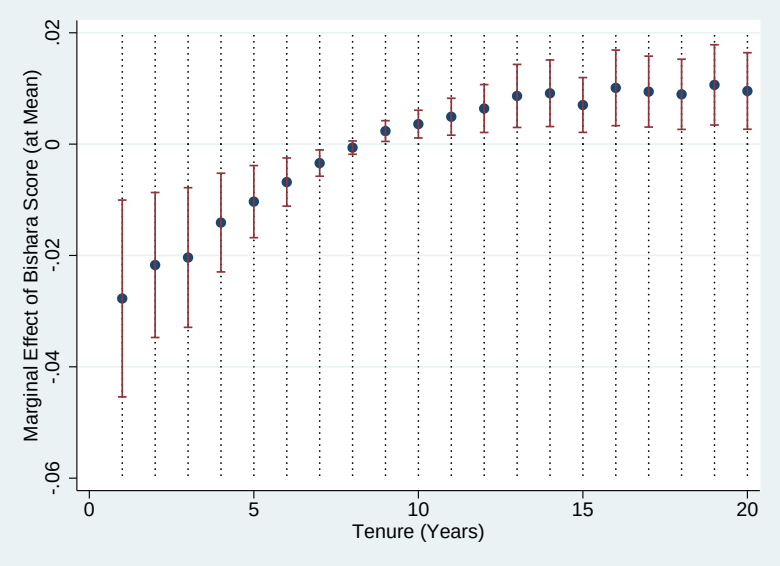
Note: Values are percentages of physicians in sample with tenure or experience within the corresponding range of years. Sample includes employed physicians who are neither partners nor sole owners of the practices at which they work, and who had graduated from medical school within the prior 27 years.

Table 17: Negative Binomial Fixed Effects Models of Job Tenure

	(1)		(2)		(3)	
	β	SE	β	SE	β	SE
NCA	0.113 **	[0.049]				
Bishara Score*NCA			0.254 ***	[0.082]	0.188 ***	[0.056]
Bishara Score					−0.185 ***	[0.059]
Office-Based	0.112	[0.070]	0.106	[0.070]	0.186 ***	[0.057]
Free-Standing Practice	0.083	[0.203]	0.074	[0.201]	−0.172	[0.177]
University Practice	0.101	[0.104]	0.111	[0.103]	0.260 ***	[0.078]
Multi-Specialty Practice	−0.050	[0.050]	−0.054	[0.050]	−0.061 *	[0.034]
Small Practice	−0.131 **	[0.061]	−0.136 **	[0.060]	−0.103 **	[0.041]
Part Owner	0.277 ***	[0.053]	0.290 ***	[0.053]	0.240 ***	[0.033]
Internal Medicine	−0.020	[0.067]	−0.027	[0.067]	−0.078 *	[0.045]
Pediatrics	0.020	[0.060]	0.009	[0.060]	−0.018	[0.037]
Secondary Specialty	0.007	[0.058]	−0.006	[0.058]	−0.040	[0.042]
Male	0.050	[0.050]	0.049	[0.049]	0.032	[0.034]
Employed Spouse	0.023	[0.051]	0.020	[0.050]	0.061 *	[0.035]
US Med. School	0.293 ***	[0.073]	0.290 ***	[0.073]	0.324 ***	[0.054]
Log Potential Experience	0.059 ***	[0.004]	0.060 ***	[0.004]	0.066 ***	[0.003]
Primary Care Market Effects	Yes		Yes		No	
Log Likelihood	-1206.28		-1204.20		-2502.44	
N	648		648		892	

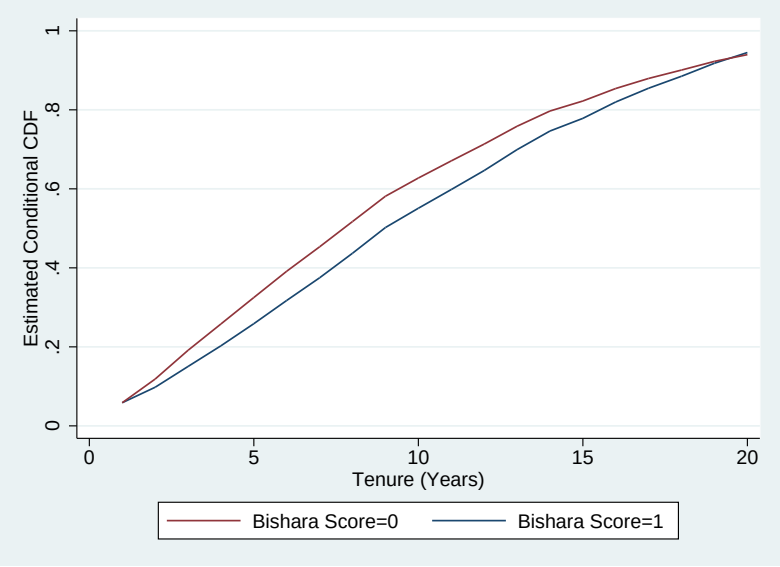
Notes: Dependent variable is number of years of tenure at current job for physicians who completed medical school within the prior 27 years. Models 1 and 2 include Primary Care Service Area market effects, as defined by the Dartmouth Atlas of Health Care, and all models include race indicators and county-level unemployment and uninsurance rates. Sample includes physicians with 27 or fewer years of experience, excludes sole owners, and includes primary care markets with at least two observations. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

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. 95% confidence intervals shown in bars.

Figure 4: Estimated Conditional CDF of Job Tenures



Notes: CDF calculated based on average marginal effects of NCA enforceability at Bishara Score=0 and Bishara Score=1 by year of tenure.

Table 19: Unconditional Mean Prices by NCA Use

	NCA	No NCA
Mean Price	\$91.14	\$89.14
(S.E.)	(2.90)	(\$2.29)

Notes: Data 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?' Sample size is 711 respondents. P-value of t-test is 0.64.

Table 20: Fixed Effects Models: Prices Charged by Practices that Use NCAs

	(1)		(2)		(3)	
	β	SE	β	SE	β	SE
NCA	−1.24	[4.54]	2.05	[8.26]		
Bishara Score*NCA					2.03	[11.88]
Office-Based	12.60	[10.61]	3.11	[20.15]	3.01	[20.19]
Free-Standing Practice	−8.58	[15.07]	−30.05	[25.52]	−30.18	[25.53]
University Practice	46.91	[38.02]	40.66	[57.72]	41.00	[57.21]
Large Practice (25+)	−5.44	[5.59]	−5.01	[10.94]	−4.97	[10.96]
Multi-Specialty Practice	0.30	[5.35]	5.00	[9.39]	5.23	[9.28]
Part Owner	−8.45 *	[4.57]	−9.44	[7.58]	−9.27	[7.60]
Independent Contractor	6.20	[12.62]	−3.76	[15.28]	−3.55	[15.38]
Internal Medicine	10.22 *	[6.16]	8.15	[11.11]	8.11	[11.11]
Pediatrics	−2.65	[4.79]	−5.42	[8.07]	−5.49	[8.00]
Secondary Specialty	25.65 ***	[6.38]	31.46 ***	[9.73]	31.38 ***	[9.75]
US Med. School	15.52 ***	[5.56]	18.40 **	[9.08]	18.35 **	[9.08]
Male	−2.14	[4.70]	−3.28	[7.96]	−3.37	[7.98]
Job Tenure	−0.52	[0.37]	−0.81	[0.64]	−0.81	[0.64]
Potential Experience	0.12	[0.38]	0.40	[0.65]	0.40	[0.65]
County Effects	Yes		No		No	
Primary Care Market Effects	No		Yes		Yes	
R Sq.	0.34		0.60		0.60	
N	657		659		659	

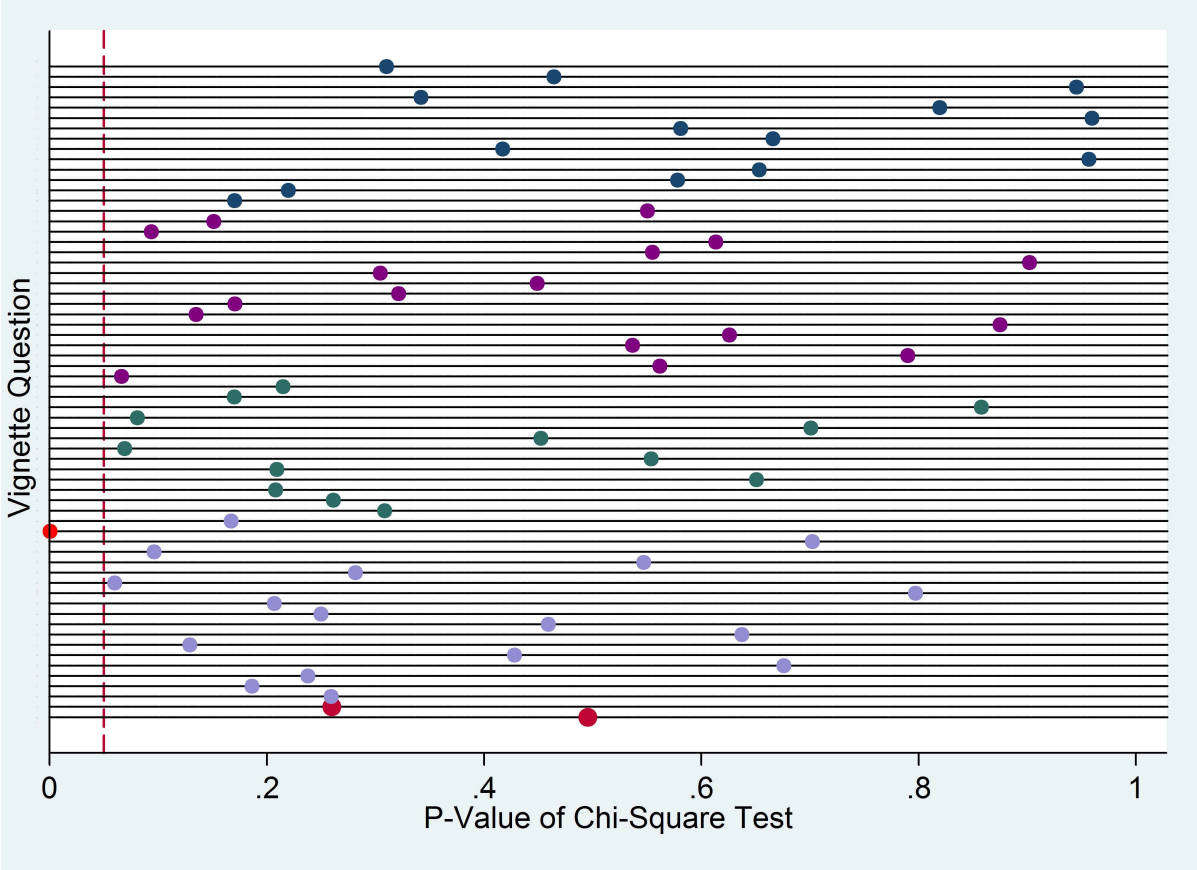
Notes: Dependent variable is the reimbursement rate for privately-insured patient. The survey question was worded: 'On average, what is your net fee after discount for an initial office visit with a private, commercially-insured patient?' Model 1 includes county effects, and Models 2 and 3 include Primary 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 18: State Selection Models

Dependent Variable	(1) Log GPs			(2) GPs Per Cap.			(3) Log GPs		
	Coeff.	S.E.		Coeff.	S.E.		Coeff.	S.E.	
Bishara Score	-0.325	0.077	***	-16.274	6.856	**	-0.295	0.142	**
Bishara Score * Low Pop. Density							0.155	0.178	
Low Pop. Density							-0.993	0.147	***
Bishara Score * Medium Pop. Density							-0.442	0.179	**
Medium Pop. Density							-0.051	0.139	
N	2965			2965			2965		
R^2	0.86			0.49			0.87		

Notes: Observations are at the county level. The dependent variable in Models 1 and 3 is the natural log of the number of office-based MDs who are not federal employees and who are actively practicing in patient care. The dependent variable in Model 2 is the physician count divided by the population in the county. Low and Medium population densities are defined as populations per square mile of 20 or fewer and between 20 and 100, respectively, based on 2000 census data. general physicians per capita in state. White-Huber heteroskedasticity-adjusted standard errors reported. * significant at 10%, ** significant at 5%, *** significant at 1%. Data sources: Bishara (2011), 2009 Area Resource File. All models also include 5th order polynomial in county population, shares of county employment by sector, county racial composition, county Medicare HMO penetration rates, log physicians assistants (per capita in Model 2), Low Nurse Practitioners (per capita in Model 2), median income, county poverty and unemployment rates, and county average education.

Figure 5: Tests of Differences in Responses to Clinical Questions:
Comparison of Physicians With and Without NCAs



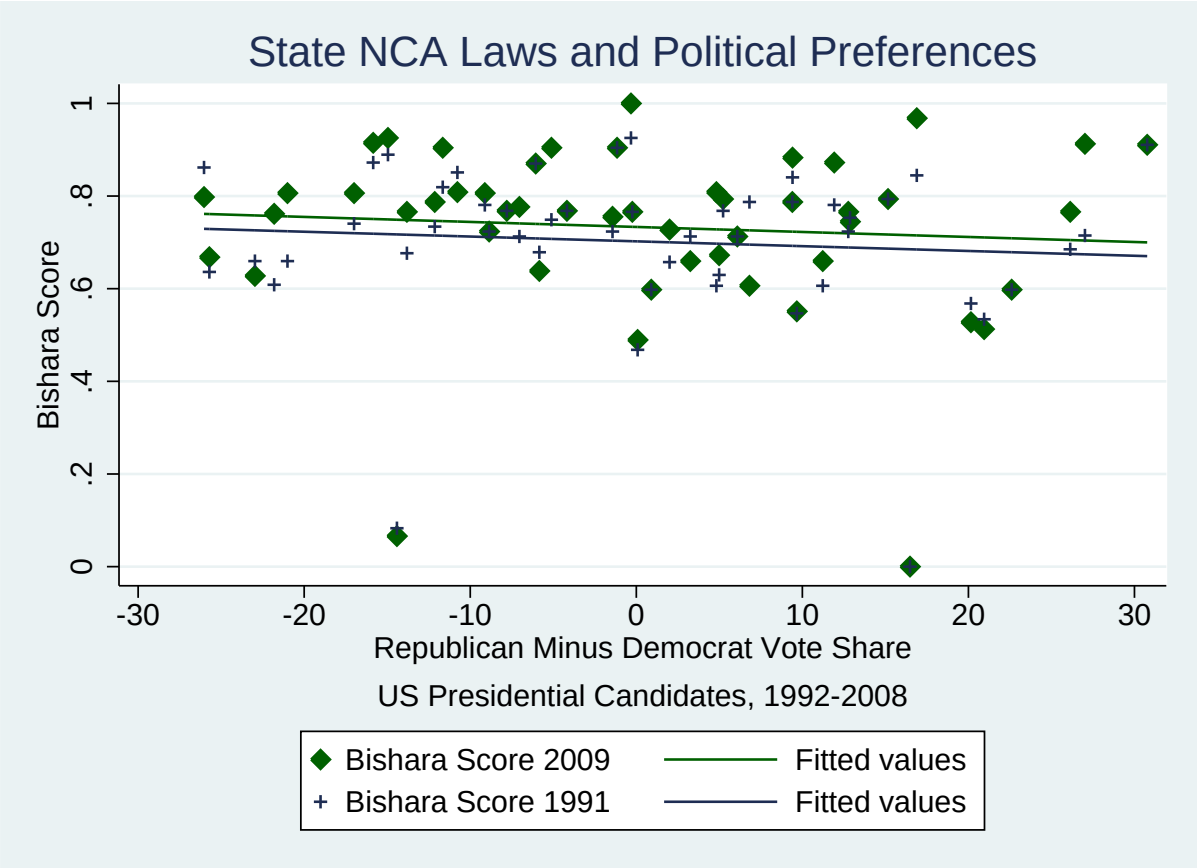
Notes: Dots are p-values of chi-square tests of the null hypothesis that physicians with NCAs gave the same responses to the corresponding vignette question as physicians without NCAs. Samples include physicians with 15 of fewer years of experience. Colors correspond to distinct vignettes, and each dot to a question related to that vignette. Dark blue dots correspond to questions related to a vignette about a hypothetical patient with symptoms of hyperlipidemia and possible depression. Purple dots correspond to questions about a vignette regarding adult asthma. Dark green dots correspond to vignette sent to pediatricians only about a child with headaches and fatigue that probes questions about a potential diagnosis of depression. Lavender dots correspond to a vignette sent to pediatricians only about a child with asthmatic symptoms. Red dots in bottom two rows are p-values of test for differences in Asthma Guideline Compliance, which is a comparison of responses to questions with established clinical guidelines for the treatment of asthma, as defined by the NHLBI and AAP. 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.

Table 21: Probit Model: Are Physicians with More Experience
Prior to their Current Job More Likely to Have NCAs?

	β		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	−0.25	***	[0.05]
University Practice	−0.14	***	[0.05]
Large Practice (25+)	0.06		[0.03]
Multi-Specialty Practice	0.17	***	[0.03]
Part Owner	0.12	***	[0.03]
Independent Contractor	−0.01		[0.06]
% Patients Uninsured	0.00		[0.00]
US Med. School	0.12	***	[0.03]
N	1532		

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. * $p < 0.10$, ** $p < 0.05$, *** $p < .01$.

Figure 6: 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.