Training and Job Separation in Imperfect Labor Markets: The Case of Non-Compete Agreements

Bhargav Gopal * and Xiangru Li † ‡

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Abstract

Non-compete agreements are provisions within employment contracts that prevent workers from joining competing firms. They are prevalent in the US workforce, with 38% of workers having signed such clauses at some point in their careers. Despite their vast usage, there is limited research on the incentives for workers and firms to use non-compete agreements. We show that non-compete agreements can create one market failure – inefficient lack of job separation – while mitigating a separate market failure – inefficient provision of industry-specific investment by firms. The model yields the predictions that (i) non-compete agreements are more likely to be used in industries where employer training is more "general" and (ii) non-compete signers have longer job tenures and receive more firm-provided investment relative to similar workers without non-compete agreements. Using newly-released panel data on the usage of non-compete agreements from the NLSY97, we confirm the model's predictions. Non-compete signers are more concentrated in knowledge-intensive industries and remain with their employers for 3 more months than individuals without such agreements. Non-compete signers also receive more employer-provided investment, but do not experience higher wage growth.

*Department of Economics, Columbia University. Email: b.gopal@columbia.edu

†Department of Economics, Columbia University. Email: xl3147@columbia.edu

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1 Introduction

The theory that labor markets are perfectly competitive has come under scrutiny in recent decades (e.g. Card 2022; Naidu and Posner 2021). Non-compete agreements – provisions within employment contracts that prevent workers from joining competing firms – are often discussed as a factor that provides firms with wage-setting power. According to survey estimates, they are prevalent in the US workforce, with 38% of workers having signed non-compete agreements at some point in their careers (Starr, Prescott, and Bishara 2021). Despite their vast usage, there remains much controversy surrounding whether non-compete agreements enhance the efficiency of the labor market.[1]

Proponents of non-compete agreements argue that they increase worker retention and encourage firms to develop the industry-specific skills of their workforce.[2] The productivity gains from such investment may be shared with labor, thus increasing wage growth in the long-run. Opponents state that non-compete agreements lock workers into their jobs, creating mobility frictions that prevent workers from joining firms where they would be more productive.[3] Reduced labor market competition due to non-compete agreements may allow firms to retain labor at lower wages, thus decreasing wage growth.

In this paper, we develop a theoretical model to show how non-compete agreements can create one market failure – inefficient lack of job separation – while mitigating a separate market failure – inefficient provision of (non-contractible) industry-specific investment by firms.[4] The worker and firm's choice then of whether to include a non-compete agreement balances these two con-

[1] This controversy is recently reflected by the Federal Trade Commission's proposal to ban the enforcement of non-compete agreements in the United States ("FTC Proposes Rule to Ban Noncompete Clauses, Which Hurt Workers and Harm Competition" 2023).

[2] In perfectly competitive labor markets, firms do not profit from providing general (or, for that matter, industry-specific) skills (Becker 1962). If they were to increase the productivity of the worker by a given amount (say δ), they would need to increase compensation by δ in order to retain the worker.

[3] Critics also cite that non-compete agreements may deter business formation, as new businesses would struggle to poach workers bound under such an agreement (i.e. Aghion and Bolton 1987). In addition, firms may impose non-compete agreements upon workers who are not aware the provision is part of the employment contract, thereby allowing firms to exploit labor in the form of worse wages and working conditions.

[4] The modelling choice to make investment non-contractible is critical, and follows a long literature studying how contracts may be designed to resolve the hold-up problem (i.e. Grossman and Hart 1986; Che and Hausch 1999). If investment were contractible, the parties would choose the efficient level, with or without a non-compete agreement.

siderations. The parties sign a non-compete agreement if the productivity gains from the firm's investment outweigh the expected costs of inefficient separation.

While existing literature has documented that non-compete agreements may encourage firm-provided investments (i.e. Meccheri 2009), we contribute by showing that non-compete agreements also prevent an efficient (ex-post) matching between workers and firms. Many economists adopt the principle that contract renegotiation is costless, in which case firms may be willing to release workers from non-compete agreements in exchange for an appropriately sized buyout payment (i.e. Shi 2023; Posner, Triantis, and Triantis 2004). When job separation is socially efficient, the third party would be willing to fund such a buyout payment, thus restoring the efficient matching between workers and firms.[5] In contrast, we follow Hashimoto (1981) in assuming that workers have private information about their outside options, and that this information cannot be credibly communicated to firms. The large transaction costs associated with contracting on the worker's outside option makes renegotiation prohibitively costly, preventing efficient matches between workers and third parties from becoming realized.[6]

We believe the theory has an intuitive appeal in understanding the costs and benefits generated by mobility frictions, though we are not the first to show that contracting affects ex-ante investment decisions or the efficiency of ex-post separation decisions. For instance, Grossman and Hart (1986) show that contracting parties may allocate authority rights at the contracting phase to encourage the provision of non-contractible investments by the more productive party. MacLeod and Malcomson (1993) demonstrate that fixed-wage contracts that require the mutual consent of both parties for renegotiation encourage firms to provide the efficient level of relationship-specific investments. Acemoglu and Pischke (1999) show that when mobility frictions increase in a worker's skill, firms

[5] Workers who are not wealth constrained may also independently fund the buyout payment. More generally, when matching with the third party is socially efficient and the parties are not wealth constrained, the buyout payment offered to the incumbent firm may be split arbitrarily between the worker and the third party. This is nothing other than a restatement of the Coase Theorem.

[6] To further elaborate, the firm cannot verify the terms of the worker's outside offer. As such, the worker cannot renegotiate the initial wage by claiming to have a superior outside offer because the firm will assume such claims are inflated. If the parties do not have the ability to renegotiate the initial contract, there may be inefficient separations as well as inefficient lack of job separation. Our decision to prevent parties from renegotiating the contract follows the suggestion of Hart and Moore (2007), who urge scholars to develop models with ex-post inefficiencies.

are incentivized to provide general training. Pakes and Nitzan (1983) develop a model where a flat first period wage and a state-contingent second period wage can yield efficient ex-ante and ex-post matching, though they do not consider how contracting affects investment incentives.

We add to the literature by showing that mobility frictions such as those generated by non-compete agreements can be a double-edged sword – they encourage firms to provide industry-specific investment while preventing efficient job separation. Our model thus sheds insight on how the structure of contracts within workplaces influences the employer's incentives to provide transferable skills (e.g. Acemoglu and Pischke 1999; Lynch and Black 1998). Our results further imply that blanket bans on the enforcement of non-compete agreements may have short-term gains as workers flow into jobs in which they are more productive, but have long-term consequences in terms of a less-skilled workforce.

Our model predicts that non-compete signers have longer job tenures, are more likely to receive employer-provided training, and are concentrated in industries where skills are easily transferable. These predictions can be tested using newly released panel data on non-compete usage from the National Longitudinal Survey of Youth (NLSY97). The survey follows a variety of outcomes for individuals who were teenagers in 1997, though the first year the survey tracks non-compete status is 2017, when the sample is aged 32 - 38.[7] A strength of the NLSY97 is that it tracks the usage of non-compete agreements among a sample that is representative of the broader population. This feature stands in contrast to much of the related literature that analyzes the effects of non-compete agreements in narrowly defined labor markets, such as in particular occupations, industries, or firms (i.e. Shi 2023; Lavetti, Simon, and White 2020).[8]

Several descriptive statistics support the model's predictions. Individuals who sign non-compete agreements are 5 percentage points more likely to receive formal training run by the employer

[7] Of the 4441 individuals who responded to the questionnaire, 632 (14%) reported having a non-compete agreement in their contract. Among those responding to having a non-compete agreement, slightly above 90% of respondents are "Very Confident" in their answer. Among all 5678 respondents, 22% did not know whether their contract included a non-compete agreement.

[8] An exception is Rothstein and Starr (2021), who study non-compete usage in the 2017 cross-section using the NLSY97. They document that individuals who sign non-compete agreements have higher wages. Since their analysis restricts to the cross-section, they cannot study the relationship between non-compete agreement and wage growth.

than those who do not sign such agreements, and the difference is statistically significant at the 1 percent level.[9] Non-compete signers are more likely to work in knowledge-intensive industries such Professional Services than in industries requiring more routine work, such as Construction.[10] They also have longer tenures with their employers. The respondents who indicated signing a non-compete agreement in 2017 had a mean job tenure of 5.2 years, compared to 5 years among those who do not have non-compete agreements. Despite the fact that non-compete signers receive more on the job training, they do not experience higher wage growth. Between 2017 and 2019, nominal wages of non-compete signers increased by 2.8% compared to 2.5% for those without non-compete agreements. The difference is not statistically significant at conventional levels, which provides suggestive evidence that in this context, employers do not share the rents generated from increased investment with labor.

These differences may not reflect causal impacts if non-compete signers have different (observed or unobserved) characteristics than those who do not sign such agreements. Indeed, the fact that non-compete signers are more concentrated in high-wage and knowledge-intensive industries suggests that this critique may be valid. We attempt to deal with this issue in several ways. First, in cross-sectional regressions, we control for observable characteristics that may be correlated with non-compete usage and wages, such as age, potential experience, gender, and industry composition. Second, we adopt an identification strategy where we compare the trajectory of outcomes for those who signed non-compete agreements in 2017 to those that later signed non-compete agreements in 2019. If non-compete signers have time invariant un-observable characteristics that differ from those without such agreements, then this comparison nets out such differences. The results from these procedures yield qualitatively similar conclusions to the exercise that compares baseline differences. The paper proceeds as follows. Section 2 lays out the theoretical framework. Section 3 discusses data sources and Section 4 tests the model's predictions. Section 5 concludes.

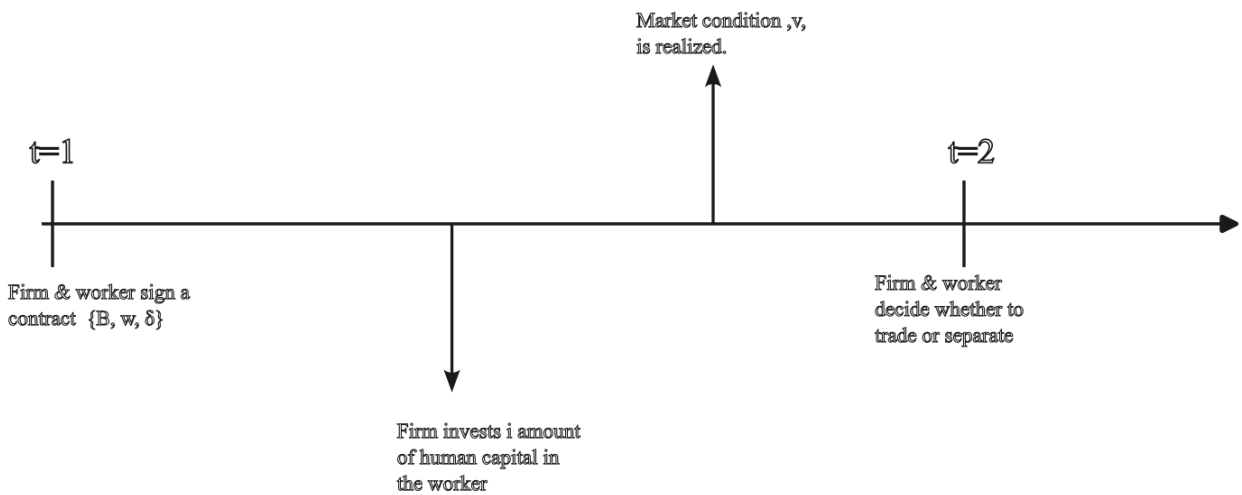
[9] This result is consistent with Starr (2019), who finds that increased state-level enforcement of non-compete agreement raises firm sponsored training.

[10] 24% of respondents working in Professional Services reported having a non-compete agreement, while 11% of respondents in Construction reported having a non-compete agreement.

2 Theoretical Framework

2.1 The Model

Figure 1: Timeline of the Model



Our model features two periods. In the first period ("ex-ante"), a single worker W and firm F choose a contract, which consists of a wage w and may include a non-compete agreement $\delta \in \{0,1\}$.[11] The non-compete agreement prevents W from moving to poaching firms θ within the same industry as F. Between the first and second period, F sinks non-contractible industry-specific investments i at unit marginal cost that raise W's productivity within F by r, should trade between the parties occur. At the time the investment is made, it is uncertain how much F's investment raises W's productivity if separation occurs. At the beginning of period 2, overall market conditions $v \sim logNormal(\mu, \sigma^2)$ are revealed and a poaching firm $\theta \in \{0,1\}$ makes an offer to W. With probability q, the poaching firm is in the same industry as the original firm $(\theta = 1)$ and values the worker at $v + \rho \times i$. With remaining probability, the poaching firm is outside of the original firm's

[11] The parties also have the option of making side payments to each other at the contracting stage. Let B denote the side-payment made by W to F at the contracting stage. We assume that $B \geq 0$. This assumption can be justified on several grounds. One reason is that it is unrealistic for workers to post bonds to employers (i.e. Baker, Gibbons, and Murphy 1994). Another is that the firm may be unable to commit to a rising wage profile or deferred benefits. Note that the wage may depend on whether the non-compete agreement is included in the contract.

industry ($\theta = 0$) and values the worker at v.[12] Observe that F's investment raises W's productivity among poaching firms only when $\theta = 1$. We assume the labor market is competitive ex-post, so the poaching firm makes an offer equal to its valuation.[13] As in Hashimoto (1981), we further assume that the poaching firm's offer is private information to the worker. After the worker receives his outside offer, the parties can trade at the contractual terms or separate.[14] To simplify matters, we suppose that the poaching firm is always an industry competitor ($q = 1$).

The incentives for parties to use a non-compete agreement will depend on a comparison between the internal return on investment r and the external return on investment ρ.[15] In our model, r and ρ can take arbitrary values, so we do not constrain firm-provided investment to be purely specific or industry-specific. We choose to be agnostic about the exact values of these parameters since they may differ across industries. For example, the internal return on investment may be large relative to the external return on investment among individuals in the Education, Health, and Social Services industry, where average job tenures are long. In contrast, the external returns on investment may be large relative to the internal return on investment in Professional and Related Services, where job-hopping between firms in the same industry is more common.[16]

The model approximates the ideal of a perfectly-competitive labor market in all but one exception – the worker has private information on the outside option which cannot credibly be communicated to the incumbent firm. Otherwise, we highlight that the poaching firm makes an offer equal to its valuation of the worker. This assumption can be justified in a setting where there are many homogeneous firms who each simultaneously bid for the worker's services. Ex-ante, the firm must offer a contract that meets or exceeds the utility value of the worker's outside option in order for the worker to accept. In perfectly competitive labor markets, this value equals the worker's utility

[12] Note that if $q = 1$ and $\rho = r$, the investment is completely general.

[13] A similar assumption is made in Spier and Whinston (1995), pg 186-188

[14] Since trade is voluntary, W can quit or F can fire. The firm's payoff from trade (net of investment) is $ri - w$, while the worker's is w. The firm's payoff from separation is 0. The worker's payoff from separation is $\bar{w} = v + \big(\theta(1 - \delta)\big)\rho \times i$. F fires the worker if $w > ri$, and W quits if $w < \bar{w}$. Since workers are not allowed to make transfer payments to the firm in the initial period, in equilibrium, the wage will always be less than the value of the worker's output.

[15] When investment is purely specific, $\rho = 0$, and when investment is purely industry-specific, $r = \rho$.

[16] As of January 2022, the median job tenure for workers in Professional and Business Services is 3.4 years, while that for Education and Social Services is 4 years: https://www.bls.gov/news.release/pdf/tenure.pdf

from accepting a job at one of many other homogeneous firms.

First, consider what happens if the parties do not include a non-compete agreement in the contract. At the investment stage, the firm chooses investment to equate marginal cost and expected marginal benefits. It earns a return of r when trade occurs, but does not earn a private return when separation occurs even though such investment would raise W's productivity by ρ. Anticipating this, F underinvests, which is the well-known hold-up problem.

One solution to the hold-up problem is for W and F to write a contract that reduces the chance that job separation occurs (i.e. Autor 2003; MacLeod and Malcomson 1993). A binding non-compete agreement fits this bill, as W is less likely to quit when $\delta = 1$ than when $\delta = 0$, holding all else equal. The non-compete agreement thus encourages F to invest more but prevents W from joining the industry competitor, even when such separation is socially efficient.[17]

2.2 Benchmark Outcomes

To more formally describe how firms under-invest relative to the socially optimal quantity without a non-compete agreement, we first characterize the planner's allocation. The social planner invests and allocates workers to firms efficiently. In the final period, the social planner executes trade between the worker-firm match if the social surplus from trade exceeds that of separation. This condition occurs when $S^T \geq S^{NT}$, where $S^T = ri_s - c(i_s)$ and $S^{NT} = v - c(i_s) + \rho i_s$. Thus it is efficient to trade if $v \leq (r-\rho)i_s$. Denote $p_s := \Phi(\frac{ln((r-\rho)i_s)-\mu}{\sigma})$ as the probability that trading is efficient from the perspective of the initial period. The efficient investment level is solved by the following equation:

$$i_s^* = \text{argmax } E(S) = -c(i_s) + (ri_s) \cdot p_s + [v + \rho i_s] \cdot (1 - p_s) \tag{1}$$

Proposition 1: If $r < \rho$, separation is always efficient and the efficient investment level is $i_s^* = \rho$. If $r > \rho$, the efficient investment level is $i_s^* = rp_s + \rho(1 - p_s)$. The probability of separation is not

[17] This occurs when $ri \geq w \geq v$ and $\rho \times i > 0$

equal to 0, and the efficient investment level increases with r and ρ.

Proof: If $r < \rho$, $P\big(v \leq (r-\rho)i_s\big) = 0$, so separation is always efficient. Solving $i_s^* = \text{argmax}\, E(S) = -c(i_s) + v + \rho i_s$ we have $i_s^* = \rho$. The efficient level of investment increases with ρ. See the appendix for case when $r > \rho$.

Corollary 1: As investment becomes more specific, the planner's probability of separation declines.

Proof: $\partial p_s / \partial (r-\rho) > 0$.

When the external return on investment is larger than the internal return on investment, poaching firms always have a higher valuation than the incumbent firm. As a result, separation is always efficient ex-post. On the other hand, when the internal return on investment is larger than the external return on investment, trading is not necessarily efficient ex-post. When market conditions are sufficiently strong, the planner assigns the worker to the poaching firm; otherwise, the planner maintains the match between the incumbent firm and worker.

2.2.1 A Simple Example

We use a simple example with exogenous investments to illustrate how non-compete agreements create "job-lock", or inefficient lack of job separation. We still use the same setup described in Subsection 2.1, but we assume that the investment level, i, is a fixed parameter. Hence the only actions are for the firm to offer a contract in period 1 and for the parties to make separation decisions in period 2. For a given wage, we compare ex-post separation decisions when non-compete agreements are and are not used.

When the worker and firm use a non-compete agreement, the worker will remain with the firm so long as the wage is less than or equal to the outside option, or when $w \leq v$. The region where trade will occur is given by the shaded region in Figure 2. The scenarios where trade occurs in a competitive equilibrium differs from the scenarios where trade occurs under an efficient allocation between workers and firms. To see this point, Figure 2 also visualizes the efficient trading rule

presented in Section 2.2. When $r > \rho$, trade is efficient whenever $v \leq (r-\rho)i$, depicted by the region below the dashed line and above the x-axis. When $\rho > r$, trading is never efficient, as the poaching firm always has a higher valuation than the incumbent firm. We observe that two types of (allocative) inefficiencies occur with a non-compete agreement. First, there are inefficient separations: there are scenarios where trade is efficient but separation occurs. This case is represented by the region below the dashed line and above the shaded area. Second, there are cases where separation is efficient but where it does not occur. This case is depicted by i) The shaded region when $r-\rho < 0$ and ii) the shaded region above the dashed line when $r-\rho > 0$.

Under the assumptions of our model, all efficient separations are realized when a non-compete agreement is excluded from the contract. When the worker's outside option exceeds the firm's valuation, that is when $v+\rho \cdot i > ri$, the worker always quits. To see why this is the case, observe that the firm will never offer a contract where it earns negative profits ex-post.[18] Hence $w \leq ri < v+\rho \cdot i$, so the worker will quit when separation is efficient. However, for any given wage, inefficient quits are more likely to occur without a non-compete agreement than with a non-compete agreement.[19]

This example illustrates that inefficient separation decisions occur both with and without a non-compete agreement. Since the initial wage cannot be renegotiated ex-post, there are instances where the worker finds it profitable to quit even though the incumbent firm has the highest valuation. There are inefficient quits without a non-compete agreement, but all efficient separations are achieved. The reason is that the wage never exceeds the incumbent firm's valuation, so the worker will quit when a poaching firm has the highest valuation. In the presence of a non-compete agreement, there are scenarios where efficient job separation is not realized, as the agreement may block the worker from moving to a poaching firm with a higher valuation. However, there are fewer inefficient quits with a non-compete agreement than without a non-compete agreement.

[18] This conclusion is a consequence of our assumption that workers cannot make transfer payments to firms in the initial period (i.e. $B \geq 0$)

[19] Observe that $Pr(v > w | v \leq (r-\rho)i_s) < Pr(v+\rho \cdot i > w | v \leq (r-\rho)i_s)$

Figure 2: Separation Decisions with a Non-Compete Agreement

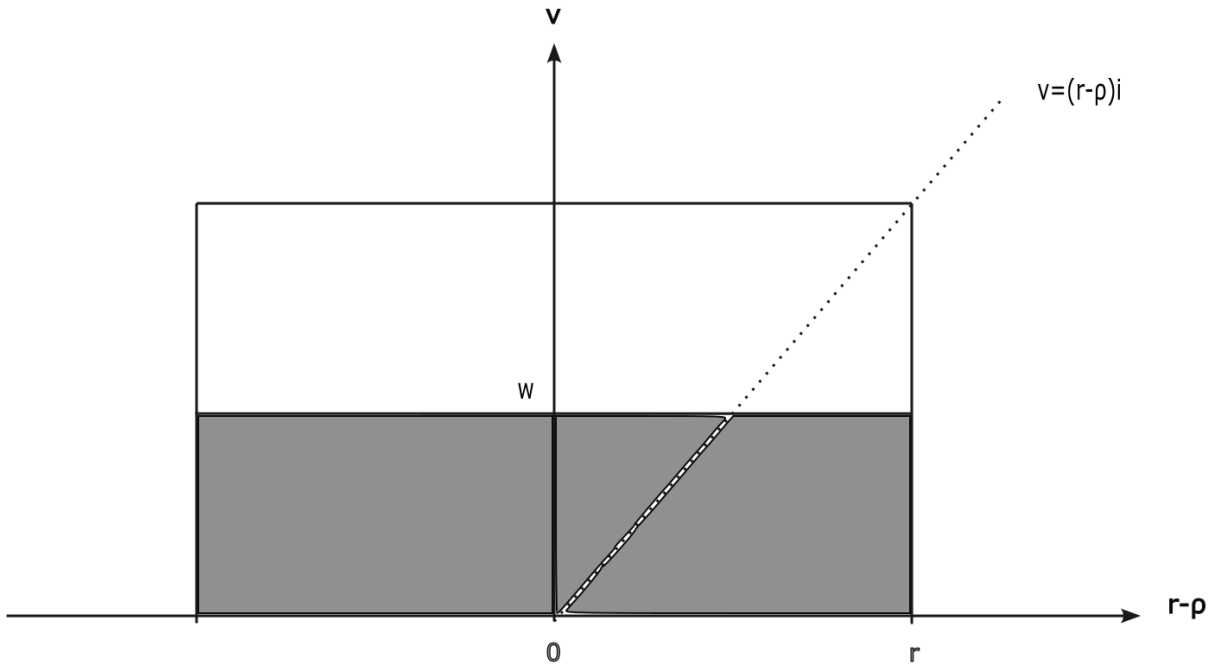
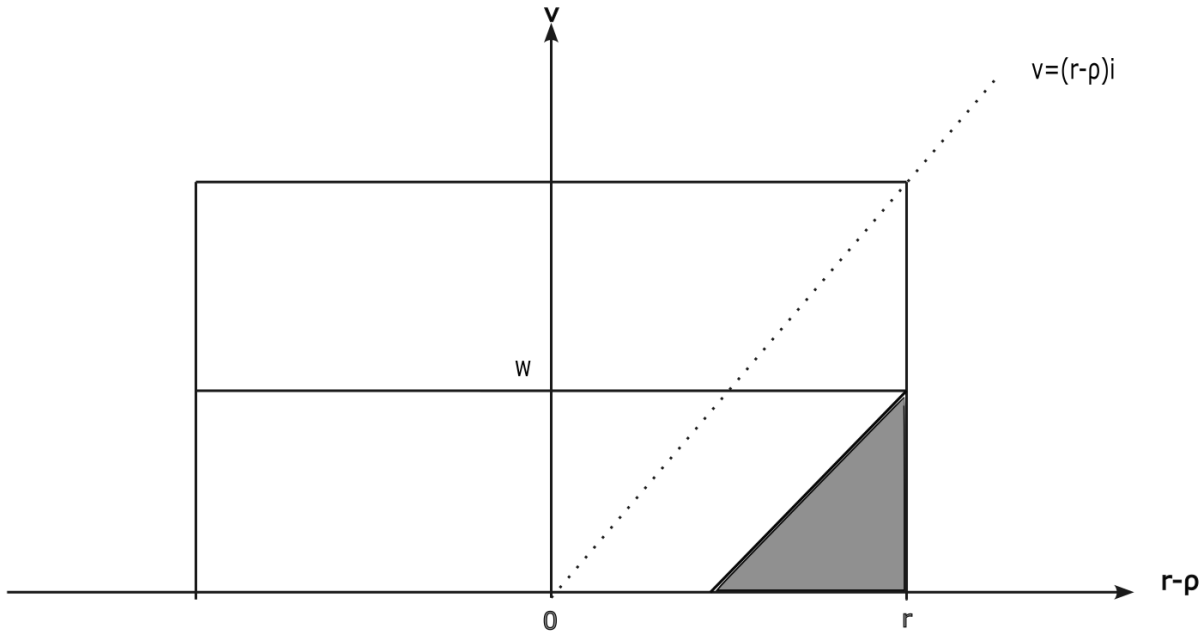


Figure 3: Separation Decisions without a Non-Compete Agreement



2.3 General Results

We solve for the Subgame Perfect Nash Equilibrium. At $t = 2$, the worker quits if the outside option is higher than the wage they receive in the last period. The outside option is v if a non-compete is signed and $v + \rho i$ if a non-compete is not signed:

$$W : \text{Stay} \iff w_\delta \geq v + \rho i_\delta (1 - \delta) \tag{2}$$

Since v is not known before investment, we denote $p_\delta = \Phi(\frac{\ln(w_\delta - \rho i_\delta(1-\delta)) - \mu}{\sigma})$ as the ex-ante probability of the match persisting. Between $t = 1$ and when market conditions are revealed, the firm makes human capital investments. We can solve for the firm's profit maximizing level of investment (conditional on the parameters of the contract) with the following equation.

$$\widetilde{i_\delta} = \text{argmax } E(\pi_\delta^F) = -c(i_\delta) - B_\delta + p_\delta(ri_\delta - w_\delta) \tag{3}$$

In the first period, the firm offers a contract that specifies a wage, bonus, and may contain a non-compete agreement. It makes this choice taking into account the participation constraints of the worker and firm, as well as by anticipating decisions later in the game. Since the firm offers the contract, the worker's participation constraint is binding, so that $E(\pi^W) = \mu_0$.[20]

$$w_\delta^*, B_\delta^* = \text{argmax } E(\pi_\delta^F) \text{ s.t. } E(\pi_\delta^F) \geq 0,\ E(\pi_\delta^W) = \mu_0, \text{ and } B_\delta \geq 0 \tag{4}$$

Proposition 2: When a non-compete agreement is not signed, the firm will under-invest relative to the socially optimal quantity ($i_0^* \leq i_s^*$). When $r \geq \rho$, there is always inefficient separation ($0 < p_0^* \leq p_s^* < 1$). When $\rho > r$, there is efficient turnover without a non-compete agreement.

Proof: See Appendix.

[20] Once we solve for the wage and bonus levels, we can plug into $\tilde{i_\delta}$ to arrive at i_δ^*.

Proposition 3: There is more employer-provided investment ($i_0^* \leq i_1^*$), higher cross-sectional wages ($w_0^* \leq w_1^*$) and less turnover ($0 < p_0^* \leq p_1^* < 1$) with a non-compete agreement than without a non-compete agreement.

Proof: See Appendix.

Proposition 4: When $r < \rho$, a non-compete agreement is always used. When $r > \rho$, it is ambiguous whether the parties use a non-compete agreement.

Proof: See Appendix.

2.4 Discussion

Propositions 1-4 constitute our main theoretical results and provide a framework to guide our empirical analysis. First, we characterize the efficient allocation, which consists of an investment level and an ex-post mapping between workers and firms. We show that the efficient level of investment increases as we raise the return on investment. Next, we show that absent a non-compete agreement, there is under-investment relative to the socially optimal quantity. This well-known hold-up problem occurs in our context because there are inefficient separations without a non-compete agreement. Our main theoretical result is that a non-compete agreement lowers turnover and raises firm-provided investment, thereby mitigating the hold-up problem. If the external returns on investment are large relative to the internal returns on investment, the probability of a job separation is large without a non-compete agreement. The firm thus has an incentive to use a non-compete agreement to raise investment and profits. In the remaining cases, the firm uses a non-compete agreement if the gains from a higher expected return on investment outweigh the costs from higher wages.

In our model, non-compete signers earn higher wages because firms must compensate workers for their reduced option value of job search. We show in Appendix Section 6.4 that workers receive compensation for signing a non-compete agreement in the form of higher wages rather than an up-front bonus. All else equal, firms prefer to provide compensation with higher wages, since higher

wages reduce the probability of a job separation.[21]

Our empirical results do suggest that non-compete signers earn higher cross-sectional wages, which is consistent with our theoretical prediction.[22] However, the predicted effect of non-compete agreements on wages may be negative under modified modelling assumptions. In our Monopsony Appendix, we extend our baseline model so that a single firm offers a contract to hetereogenous workers with varying reservation utilities. As in Hashimoto (1981), these reservation utilities are private information to workers. We show that when the firm uses a non-compete agreement, employment is less than socially efficient and that wages may be lower than without a non-compete agreement.[23]

3 Data

We use data from the National Longitudinal Survey of Youth 1997 (NLSY97) to understand the characteristics of non-compete signers and analyze the effects of such agreements on job tenure, employer-provided training, wages, and wage growth. This dataset is a nationally representative panel that tracks the outcomes of individuals aged 12-16 in 1997. The NLSY97 starts measuring whether non-compete agreements are used within employment contracts starting in 2017, when survey respondents are between ages 32-36. In 2017, all working respondents are asked whether they have a non-compete agreement. In 2019, the following survey round, only individuals who obtained a new job between survey rounds are asked about their non-compete status.

In 2017, 5678 individuals responded to the questionnaire, of which 22% reported being unaware of whether they had a non-compete agreement in their contract (Table A1). Among the

[21] Both higher wages and up-front bonus payments raise the worker's utility, but up-front bonus payments do not affect the worker's decision to quit or stay ex-post.

[22] In our fully saturated model that includes controls for tenure, age, gender, potential experience, and industry, we find that non-compete agreements are associated with 16% higher wages in the 2017 cross-section and 20% higher wages in the 2019 cross-section.

[23] By lowering wages, the monopsonistic firm attracts fewer workers but earns more profits per worker. Without a non-compete agreement, the firm has employment less than the socially efficient level and earns positive (ex-post) profits per worker (Proposition A1). A non-compete agreement may result in even lower wages and employment than without a non-compete agreement if the gains in profit-per-worker exceed the losses in employment. However, whether this occurs depend on the exact parameters of our theoretical model.

remaining 4441 respondents, 632 (14%) indicated that they had a non-compete agreement. More than 90% of affirmative respondents reported being "Confident" or "Very Confident" in their answer. We obtain similar rates of non-compete usage when we look at responses in the 2019 survey round: among the 2612 individuals who obtained new jobs between survey rounds, 309 respondents (12%) reported having a non-compete agreement (Table A3).[24] There is substantial heterogeneity in non-compete usage across the 17 (two-digit) industries considered. Table 1 shows that among industries with more than 100 respondents, non-compete agreements are most commonly used in Professional and Related Services (24%) and least commonly used in Educational, Health, and Social Services (9%).

We are interested in the relationships between non-compete agreements and various labor market outcomes. We measure job tenure in years and job separation as an indicator variable for whether an individual separated jobs between survey years.[25] Employer-provided training is measured in several ways; we consider whether the employer directly provides training as well as whether training from a third party is provided at the workplace. As a default, we report statistics pertaining to whether an individual has ever previously received employer-provided training in a given job. We observe the hourly wages of respondents in all survey years between 2013 and 2019, allowing us to assess whether non-compete signers have higher or lower wage growth relative to individuals who do not sign such agreements. This data also allows us to inquire whether non-compete signers have higher wages in the cross-section, even after controlling for observable characteristics.

4 Results

We observe that non-compete signers earn 6 dollars more per hour, or 26% more, than individuals without non-compete agreements in the 2017 cross-section. To probe the incentives for parties in

[24] While individuals may hold multiple jobs, we restrict all analysis to an individual's primary job.

[25] The sample period runs from 2013 to 2019, and the survey years are 2013, 2015, 2017, and 2019. We consider the incidence of job separation between 2017 and 2019, as well as the incidence of job separation between 2013 and 2019.

an employment relationship to use non-compete agreements, we chart usage of these agreements by industry (Table 1). Consistent with the developed theory, we observe greater prevalence of non-compete agreements in higher-wage industries where knowledge may be easily transferable. On average, 14% of respondents have non-compete agreement, but in Professional Services and Wholesale Trade (the two industries with the highest non-compete prevalence), this number is 24% and 23% respectively.[26] In contrast, 9% of respondents report signing non-compete agreements in Public Administration and Education, Health, and Social Services, the two industries with the lowest prevalence.[27]

Individuals who report signing a non-compete agreement in 2017 have starting wages of $21 per hour, a four dollar premium relative to those who do not report signing a non-compete agreement in 2017. Differences in starting wages may reflect a compensating wage differential or differing characteristics between those who do and do not sign non-compete agreements. We are unable to assess the relative importance of both factors, though we note that the estimated cross-sectional wage premium for signing a non-compete agreement declines as we add control variables (Table A4). This implies that differences in starting wages is partly attributable to the fact that, on average, non-compete signers have characteristics that are positively associated with employment outcomes.

Table 2 provides further evidence that supports this claim. In the 2017 cross-section, we find that non-compete signers stay with their employers for 3 more months and are 4 percentage points less likely to have a job separation than their counterparts, which is consistent with our theory. They also have, on average, a half year more of formal education and higher four-year college attainment rates. Employers are more likely to provide training to those who sign a non-compete agreement: 31% of respondents with a non-compete reported having ever received training run by the employer, relative to 27% for those without a non-compete agreement. The difference is statistically significant at conventional levels. We observe similar differentials for training provided

[26] According to the Bureau of Labor Statistics, "Sales representatives, wholesale and manufacturing, except technical and scientific products" comprise the most common occupation within Wholesale Trade.

[27] Utilities, Agriculture, Forestry, and Fisheries, and Active Duty Military have lower usage, but fewer than 30 respondents fall under these categories.

by a third party at the workplace or the incidence of receiving alternative forms of training.[28]

Table 3 examines training differentials among high and low non-compete usage industries. Our theory predicts that in industries where training is more "general," non-compete agreements are used more frequently and are more likely to encourage firm-provided investments. We observe training differentials in high-usage industries but not in low-usage industries, which is consistent with the theory. In high-usage industries, non-compete signers are 7 percentage points more likely to receive formal training run by the employer, with the difference statistically significant at the 1% level. In low-usage industries, the training differential is indistinguishable from 0. Table A7 probes even further, showing training differentials by industry. While we observe a training premium associated with non-compete agreements in the overwhelming majority of industries, limited sample sizes within industry cells prevent us from making further conclusions about the particular industries where non-compete agreements raise firm-provided investments.[29]

Despite the fact that non-compete signers receive more firm-provided training, they do not experience higher wage growth. Table 2 shows that between 2017 and 2019, both non-compete signers and non-signers experienced a 4% increase in wages. This result is not an artifact of the sample period considered. When we look at the 2015 to 2017 sample period, we again observe similar patterns of wage growth between the two groups. Figure 5 further corroborates this result by showing that there is no relationship between industry-level usage of non-compete agreements and wage growth between 2017 and 2019.

A large literature has documented that job-to-job mobility is a common source of wage growth for early-career workers (i.e. Topel and Ward 1992). We are motivated to analyze wage growth patterns by non-compete *and* job separation status, since our theory predicts that non-compete agreements lower the incidence of job separation. In this exercise, our identifying assumption is

[28]Though we note the 2 p.p. differential for training run by a third party at work is not statistically significant at the 10% level. In contrast to the firm-level investment measures in Shi (2023), we measure training at the individual-level. Our sample of workers is also approximately 10 years younger than her sample of executives (mean age of 34 in our study versus mean age of 45 in Shi (2023)). Nevertheless, we arrive at similar differences in job tenure among those with and without non-compete agreements (0.21 years in our sample versus 0.10 years among the sample of executives).

[29]Only 4 out of the 16 industries in Column 4 of Table A7 have negative coefficients. 6 out of the 16 industries in Column 8 of Table A7 have negative coefficients.

that absent a non-compete agreement, non-compete signers who remain in their jobs experience similar wage growth as those who do not sign non-compete agreements and remain in their jobs. If increased investment due to non-compete agreements generate rents that are later shared with labor, then we should observe higher wage growth among non-compete signers who are job stayers over the sample period, relative to job stayers without non-compete agreements.

We do not observe evidence of such rent-sharing in Figure 6. Among respondents who remain with their main employer between 2013 and 2019, wage growth is similar among those with and without a non-compete agreement. Interestingly, this pattern even holds among respondents who experience a job separation over the sample period.[30] When we look at patterns by high and low income status in Table 4, we arrive at similar conclusions. Among both high and low income earners, wage growth between 2017 and 2019 is 2 to 3 percent (regardless of non-compete status).[31] Articles in the popular press have often claimed that non-compete agreements are exploitative for low-income workers.[32] When we zoom into the wage patterns for low-income workers in Appendix Figure A3, we observe generally similar patterns as in the overall sample. The result that non-compete agreements are associated with higher wages is consistent with Gopal (2023), who finds higher wages under stricter regimes of non-compete enforcement.

The qualitative relationships between non-compete agreements and various labor market outcomes are robust to several identification strategies. In Tables A4 and A5, we estimate the coefficients from the following equation via Ordinary Least Squares:

$$Y_i = \beta_0 + \beta_1 * NC_i + \beta_2 * X_i + \varepsilon_i \tag{5}$$

We consider wages in 2019 as the dependent variable in the former table and wage growth between 2017 and 2019 as the dependent variable in the latter table.[33] Table A4 shows that $\hat{\beta}_1$

[30] Similar patterns arise when we define job separators to be those who experienced a job separation between 2017 and 2019 (Figure A1)

[31] Low (high) income workers are defined to be those earning below (above) median wages in 2015.

[32] See for example this article about non-compete agreements in the fast-food industry: https://www.nytimes.com/2014/10/15/upshot/when-the-guy-making-your-sandwich-has-a-noncompete-clause.html

[33] We are motivated to use the 2019 cross-section for this exercise, since all respondents are relatively new job holders.

declines as we add control variables. In the no-controls specification in Column 1, the wage premium associated with signing a non-compete agreement is 28%. In the fully saturated model of Column 6, which has industry fixed effects and controls for age, tenure, gender, and potential experience, the estimated wage premium falls to 19%. We observe different patterns when the outcome is wage growth. Across all specifications, the coefficient on the non-compete dummy variable remains constant at 0.003 and is statistically insignificant at conventional levels.

Even in the fully saturated model, we cannot rule out the possibility that there are omitted variables correlated with non-compete usage and labor market outcomes of interest. Our developed theory suggests that individuals who sign non-compete agreements have high external returns on firm provided investment.[34] If these individuals also have higher ability, then our estimated coefficients will be upward biased. To address this concern, we adopt a research design where we compare the trajectory of outcomes of individuals who signed non-compete agreements in 2017 to that of individuals who signed non-compete agreements in 2019. If those who ever sign a non-compete agreement have higher time-invariant un-observable characteristics, then this comparison nets out such differences. More formally, using the full sample of non-compete signers and data from 2013 to 2019, we estimate the parameters of the following Event Study regression:

$$Y_{it} = \beta^0 + \beta^1 * 1(NC_{2017}) + \sum_{t \neq 2017} \beta^t 1(NC_{2017}) * 1(Year = t) + \varepsilon_{it} \tag{6}$$

We are interested in $\hat{\beta^1}, \hat{\beta^{2013}}$, and $\hat{\beta^{2015}}$, which represent annual differences in labor market outcomes between the treatment and control groups prior to when members of the control group signed non-compete agreements. The coefficients in Table 5 provide further suggestive evidence that non-compete agreements are associated with higher cross-sectional wages, job-tenures, and employer-provided training, and are not associated with wage-growth.[35]

[34] The "external return on firm provided investment" corresponds to the parameter ρ in the theoretical model.

[35] We do caution, however, that these coefficients may still not reflect the causal impact of non-compete agreements. Members of the treatment and control group may have different time-varying un-observable characteristics that affect our labor market outcomes of interest. Further, non-compete agreements may be bundled with other post-employment restrictions that affect our outcomes of interest.

5 Conclusion

Economists have long been interested in the factors that promote human capital development. Schooling is often considered as an important determinant of an individual's productivity, but there are many skills that can only be learned on the job. The market for employer-provided training, however, suffers a well-known failure: employers do not have an incentive to provide transferable skills if they later need to compensate workers for their increased productivity.

In this paper, we consider the incentives for workers and firms to use non-compete agreements and empirically study their effects on various labor market outcomes. We show that non-compete agreements are used if the gains from transferable skills provided by firms outweigh the expected costs of job-lock. While we view this trade-off between efficient investment and job-separation as intuitive, the model departs from the existing theoretical literature by allowing for ex-post inefficiencies. That is to say, non-compete agreements may prevent workers from moving to firms where they are more productive.

Using newly released panel data on non-compete usage among a representative sample of workers, we confirm the model's predictions. Non-compete agreements lower job separation rates, increase firm provided investments, raise cross-sectional wages, and are more likely to be used in industries where training is easily transferable. We find no relationship between non-compete agreements and wage growth, suggesting that the rents generated from increased investment are not shared with labor in the short-run.

Our empirical analysis departs from existing literature in several ways. We directly examine the effect of non-compete agreements, as opposed to a large body of work that studies the impacts of non-compete regulation (i.e. Gopal (2023)). By using a moderately large and representative sample, we have been able to study the effects of non-compete agreements on the broader workforce, unlike previous studies that focus on particular occupations, industries, or firms. Our results are thus more likely to generalize to broader segments of the economy relative to existing literature.

Although our analysis provides a better understanding of the usage and impacts of non-compete agreements, future research can address some of the limitations of this study. Our data-set first

measures usage of non-compete agreements in 2017 and concludes in 2019, so our panel is relatively short. A panel that tracks individuals across a longer horizon would allows us to determine the longer-run impacts of non-compete agreements. In addition, non-compete agreements may be bundled with other post-employment restrictions, such as non-disclosure agreements and no-solicitation agreements. If such bundling is a common occurrence (i.e. Balasubramanian et al. 2022), then our results identify the joint effects of non-compete agreements and other post-employment restrictions. Nevertheless, this study contributes to the literature by illustrating the incentives for parties to use non-compete agreements and directly analyzing the effects of such agreements on a broad sample.

6 Appendix

6.1 Proposition 1

When $r > \rho$, we solve for the efficient investment level as follows:

$i_s^* = \text{argmax } E(S) = -c(i_s) + p_s \cdot ri_s + (1-p_s)\rho i_s + (1-p_s) \cdot E(v \mid v \geq (r-\rho)i_s)$

We know that $E(v \mid v \geq (r-\rho)i_s) = \frac{1}{1-p_s}\int_{(r-\rho)i_s}^{\infty} \frac{1}{\sigma}\phi(\frac{\ln t-\mu}{\sigma})\,dt$

Denote $v(i_s) = (r-\rho)i_s$. Take the FOC with respect to i:

$$-i_s^* + rp_s + \frac{\partial p_s}{\partial i_s^*} ri_s^* + (1-p_s)\rho - \frac{\partial p_s}{\partial i_s^*}\rho i_s^* - (r-\rho)\frac{1}{\sigma}\phi(\frac{\ln v(i_s)-\mu}{\sigma}) = 0$$

$$-i_s^* + rp_s + \frac{r}{\sigma}\phi(\frac{\ln v(i_s)-\mu}{\sigma}) + (1-p_s)\rho - \frac{\rho}{\sigma}\phi(\frac{\ln v(i_s)-\mu}{\sigma}) - (r-\rho)\frac{1}{\sigma}\phi(\frac{\ln v(i_s)-\mu}{\sigma}) = 0$$

$$-i_s^* + rp_s + (1-p_s)\rho = 0$$

$$\implies i_s^* = r\int_0^{(r-\rho)i_s^*} \frac{1}{t\sigma}\phi(\frac{\ln v(i_s^*)-\mu}{\sigma})\,dt + \rho\int_{(r-\rho)i_s^*}^{\infty} \frac{1}{t\sigma}\phi(\frac{\ln v(i_s^*)-\mu}{\sigma})\,dt$$

$$\frac{\partial i_s^*}{\partial r} = r\frac{\partial p_s}{\partial r} + p_s - \rho\frac{\partial p_s^*}{\partial r}$$

$$\frac{\partial i_s^*}{\partial r} = \int_0^{(r-\rho)i_s^*} \frac{1}{t\sigma}\phi(\frac{\ln v(i_s^*)-\mu}{\sigma})\,dt + \frac{r-\rho}{(r-\rho)i_s^*\sigma}\cdot\phi(\frac{\ln v(i_s^*)-\mu}{\sigma})\cdot[(r-\rho)\cdot\frac{\partial i_s^*}{\partial r} + i_s^*]$$

$$\phi(\frac{\ln v(i_s^*)-\mu}{\sigma}) \approx 0$$

$$\implies \frac{\partial i_s^*}{\partial r} \approx p_s > 0$$

Likewise,

$$\frac{\partial i_s^*}{\partial \rho} = \int_{(r-\rho)i_s^*}^{\infty} \frac{1}{t\sigma}\phi(\frac{\ln v(i_s^*)-\mu}{\sigma})\,dt + \frac{r-\rho}{(r-\rho)i_s^*\sigma}\cdot\phi(\frac{\ln v(i_s^*)-\mu}{\sigma})\cdot[(r-\rho)\cdot\frac{\partial i_s^*}{\partial r} - i_s^*]$$

$$\implies \frac{\partial i_s^*}{\partial \rho} \approx 1 - p_s > 0$$

6.2 Proposition 2

By solving for the value that optimizes Equation 3, we arrive at $\widetilde{i_0} = \widetilde{p_0}r + \frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}(r\widetilde{i_0} - w_0)$, where we denote $\widetilde{p_0} = \Phi(\frac{\ln(w_0-\rho\widetilde{i_0})-\mu}{\sigma})$. Since $\frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}} \leq 0$, $\widetilde{i_0} < \widetilde{p_0}r = \Phi(\frac{\ln(w_0-\rho\widetilde{i_0})-\mu}{\sigma})r$. Meanwhile, the firm is earning a non-negative profit, resulting in $w_0 < ri_0^*$. Since Φ is a strictly increasing function, we have $i_0^* < r\Phi(\frac{\ln(w_0-\rho i_0^*)-\mu}{\sigma}) < r\Phi(\frac{\ln(r-\rho)i_0^*)-\mu}{\sigma})$. From Section 2.2, we know the socially efficient investment level is $i_s^* = rp_s + \rho(1-p_s)$, which means that $i_s^* > rp_s = r\Phi(\frac{\ln(r-\rho)i_s^*)-\mu}{\sigma})$. Consider the fixed point of the function $f(x) = r\Phi(\frac{\ln(r-\rho)x)-\mu}{\sigma})$. The previous inequalities imply that $i_0^* < x < i_1^*$, which proves our case.

Now, we turn to prove $p_0^* < p_s$. If a non-compete agreement is not signed, the worker will not quit if and only if $v \leq w_0 - \rho i_0^*$. For the firm to earn profits, the wage must be less than output: $w_0 < ri_0$. As a result, trade will occur when $v \leq (r-\rho)i_0^*$. For the planner, it is efficient to trade if $v \leq (r-\rho)i_s^*$. Since we have proven that $i_0^* < i_s^*$, it now follows that $p_0^* < p_s^*$.

6.3 Proposition 3

We cannot solve for the algebraic form of i_0^*, though we will prove that $i_0^* < i_1^*$. Observe that when $\rho = 0$, the non-compete case is the same as the case without a non-compete. Thus, we only need to show that $\frac{di_0^*}{d\rho} < 0$ in order to prove that $i_0^* < i_1^* \ \forall \rho > 0$, as i_1^* does not change with ρ.

When non-compete is not signed, we solve for equilibrium wage and investment first. From Equation 3, we can arrive at $\widetilde{i_0} = \widetilde{p_0} r + \frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}(r\widetilde{i_0} - w_0)$. Now since $\frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}} = -\rho \cdot \frac{1}{(w_0 - \rho \widetilde{i_0})\sigma} \cdot \phi(\frac{\ln(w_0 - \rho \widetilde{i_0}) - \mu}{\sigma}) < 0$, we know $\widetilde{i_0} < \widetilde{p_0} r$. Now onto the contracting stage, given that the worker's expected payoff binds at μ_0, we find the wage that optimizes firm profit:

$$E(\pi_0^W) = B_0 + \widetilde{p_0} w_0 + \int_{w_0 - \rho \widetilde{i_0}}^{\infty} \frac{1}{\sigma} \phi(\frac{\ln t - \mu}{\sigma})\, dt + (1 - \widetilde{p_0})\rho \widetilde{i_0} = \mu_0$$

$$E(\pi_0^F) = -c(\widetilde{i_0}) - B_0 + \widetilde{p_0}(r\widetilde{i_0} - w_0)$$

$$\implies E(\pi_0^F) = -c(\widetilde{i_0}) + \widetilde{p_0} r \widetilde{i_0} - \mu_0 + \int_{w_0 - \rho \widetilde{i_0}}^{\infty} \frac{1}{\sigma} \phi(\frac{\ln t - \mu}{\sigma})\, dt + (1 - \widetilde{p_0})\rho \widetilde{i_0}$$

Now we take derivative $\frac{\partial E(\pi_0^F)}{\partial w_0}$. Note that $\widetilde{i_0}$ is a function of w_0 and $\widetilde{p_0}$ is a function of $\widetilde{i_0}$ and w_0.

$$\frac{dE(\pi_0^F)}{dw_0} = -\widetilde{i_0} \cdot \frac{d\widetilde{i_0}}{dw_0} + \frac{d\widetilde{p_0}}{dw_0} \cdot r\widetilde{i_0} + \widetilde{p_0} r \frac{d\widetilde{i_0}}{dw_0} - (w_0 - \rho \widetilde{i_0})\frac{d\widetilde{p_0}}{dw_0} + (1 - \widetilde{p_0})\rho \frac{d\widetilde{i_0}}{dw_0} - \frac{d\widetilde{p_0}}{dw_0}\rho \widetilde{i_0}$$

$$\text{where } \frac{d\widetilde{p_0}}{dw_0} = \frac{\partial \widetilde{p_0}}{\partial w_0} + \frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}} \cdot \frac{d\widetilde{i_0}}{dw_0}$$

$$\implies \frac{dE(\pi_0^F)}{dw_0} = \overbrace{(-\widetilde{i_0} + \widetilde{p_0}r + (1-\widetilde{p_0})\rho)}^{>0 \text{ as } \widetilde{i_0} < \widetilde{p_0}r} \cdot \frac{d\widetilde{i_0}}{dw_0} + \frac{d\widetilde{p_0}}{dw_0} \cdot \overbrace{(r\widetilde{i_0} - w_0)}^{>0}$$

To determine the sign of $\frac{dE(\pi_0^F)}{dw_0}$, we need to know the signs of $\frac{d\widetilde{i_0}}{dw_0}$ and $\frac{d\widetilde{p_0}}{dw_0}$. Take total derivatives from $\widetilde{i_0} = \widetilde{p_0}r + \frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}(r\widetilde{i_0} - w_0)$

$$\begin{aligned}
\frac{d\widetilde{i_0}}{dw_0} &= \frac{d\widetilde{p_0}}{dw_0}r + \overbrace{\frac{\partial^2 \widetilde{p_0}}{\partial \widetilde{i_0}\partial w_0}}^{\approx 0}(r\widetilde{i_0} - w_0) + \overbrace{\frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}}^{<0}(r\frac{d\widetilde{i_0}}{dw_0} - 1) \\
&= r(\frac{\partial \widetilde{p_0}}{\partial w_0} + \frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}} \cdot \frac{d\widetilde{i_0}}{dw_0}) + \frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}(r\frac{d\widetilde{i_0}}{dw_0} - 1)
\end{aligned}$$

$$\implies \overbrace{(1 - 2r\overbrace{\frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}}^{<0})}^{>0} \cdot \frac{d\widetilde{i_0}}{dw_0} = r\overbrace{\frac{\partial \widetilde{p_0}}{\partial w_0}}^{>0} - \overbrace{\frac{\partial \widetilde{p_0}}{\partial \widetilde{i_0}}}^{<0}$$

This implies that $\frac{d\widetilde{i_0}}{dw_0} > 0$ and $\frac{d\widetilde{p_0}}{dw_0} > 0$. Thus $\frac{dE(\pi_0^F)}{dw_0} > 0$ for all w_0 within the boundary. Given this, the profit is maximized at the higher bound for w_0, which happens when we have $B_0 = 0$ binding. The equilibrium w_0^* satisfies the following equation.

$$p_0^* w_0^* + \int_{w_0^* - \rho i_0^*}^{\infty} \frac{1}{\sigma}\phi(\frac{\ln t - \mu}{\sigma})\, dt + (1 - p_0^*)\rho i_0^* = \mu_0$$

With this, we can also solve for the investment i_0^*. Now that we have the first period wage and optimal investment solved implicitly, we can see how i_0^* changes with ρ. Taking the total derivative of the function above with respect to ρ, we have

$$\frac{dp_0^*}{d\rho}w_0^* + p_0^* \cdot \frac{dw_0^*}{d\rho} - (w_0^* - \rho i_0^*) \cdot \frac{dp_0^*}{d\rho} - \frac{dp_0^*}{d\rho}\rho i_0^* + (1 - p_0^*)i_0^* + (1 - p_0^*)\rho\frac{di_0^*}{d\rho} = 0$$

$$\implies p_0^* \cdot \frac{dw_0^*}{d\rho} + \overbrace{(1 - p_0^*)i_0^*}^{>0} + (1 - p_0^*)\rho\frac{di_0^*}{d\rho} = 0$$

Now to learn the sign for $\frac{di_0^*}{d\rho}$ and $\frac{dw_0^*}{d\rho}$, we can turn to the optimal investment function $i_0^* =$

$p_0^* r + \frac{\partial p_0^*}{\partial i_0^*}(r i_0^* - w_0^*)$

Taking the total derivative of the function with respect to the variable ρ, we have

$$\frac{di_0^*}{d\rho} = r \cdot (\frac{\partial p_0^*}{\partial w_0^*} + \frac{\partial p_0^*}{\partial i_0^*} \cdot \frac{di_0^*}{dw_0^*}) + \overbrace{\frac{\partial^2 p_0^*}{\partial i_0^* \partial \rho}}^{\approx 0}(i_0^* - w_0^*) + \frac{\partial p_0^*}{\partial i_0^*}(r\frac{di_0^*}{d\rho} - \frac{dw_0^*}{d\rho})$$

$$\implies \overbrace{(1 - 2\overbrace{\frac{\partial p_0^*}{\partial i_0^*}}^{<0})}^{>0} \frac{di_0^*}{d\rho} = \overbrace{(r \cdot \overbrace{\frac{\partial p_0^*}{\partial w_0^*}}^{>0} - \overbrace{\frac{\partial p_0^*}{\partial i_0^*}}^{<0})}^{>0} \cdot \frac{dw_0^*}{d\rho}$$

From the optimal investment equation, we can see that $\frac{di_0^*}{d\rho}$ and $\frac{dw_0^*}{d\rho}$ have the same sign. Thus we can denote $\frac{di_0^*}{d\rho} = k\frac{dw_0^*}{d\rho}$ with $k > 0$.

Plug this into the function $p_0^* \cdot \frac{dw_0^*}{d\rho} + \overbrace{(1 - p_0^*) i_0^*}^{>0} + (1 - p_0^*)\rho \frac{di_0^*}{d\rho} = 0$ we have

$$\overbrace{(1 - p_0^*) i_0^*}^{>0} + \overbrace{((1 - p_0^*)\rho + p_0^* k)}^{>0} \frac{di_0^*}{d\rho} = 0$$

From this we have successfully proven that $\frac{di_0^*}{d\rho} < 0$, which implies that $i_0^* < i_1^*, \forall \rho > 0$.

Likewise, when $\rho = 0$, we have $w_0^* = w_1^*$. And since $\frac{di_0^*}{d\rho} = \overbrace{k}^{>0} \overbrace{\frac{dw_0^*}{d\rho}}^{<0} < 0$, we also have $w_0^* < w_1^*$.

Lastly, with $\delta = 0$, trading occurs when $v \leq w_0^*$, and with $\delta = 1$, trading occurs when $v \leq w_1^* - \rho i_1^*$. From $w_1^* > w_0^*$, we have $w_0^* - \rho i_0^* < w_1^*$. Thus we have $p_0^* < p_1^*$, meaning there is a higher probability of separation when a non-compete agreement is not signed.

6.4 Proposition 4

When $\rho > r$, we have already shown that all contracts without non-compete agreements generate negative profits, so will not be used. We just need to show that there exists a contract with a non-compete agreement that generates positive profits. Such an illustration will prove that a non-compete agreement will be used.

From Equation 3, we can arrive at $\widetilde{i_1} = \widetilde{p_1} r$, where we denote $\widetilde{p_1} = \Phi(\frac{\ln w_1 - \mu}{\sigma})$. Now onto the contracting stage, given that the worker's expected payoff binds at μ_0, we find the wage that optimizes firm profit:

$$E(\pi_1^W) = B_1 + \widetilde{p_1} w_1 + \int_{w_1}^{\infty} \frac{1}{\sigma} \phi(\frac{\ln t - \mu}{\sigma})\, dt = \mu_0$$

$$E(\pi_1^F) = -c(\widetilde{i_1}) - B_1 + \widetilde{p_1}(r\widetilde{i_1} - w_1)$$

$$\implies w_1^* = \text{argmax } E(\pi_1^F) = -c(\widetilde{i_1}) + \widetilde{p_1} r\widetilde{i_1} - \mu_0 + \int_{w_1}^{\infty} \frac{1}{\sigma} \phi(\frac{\ln t - \mu}{\sigma})\, dt \text{ s.t. } B_1 \geq 0, E(\pi_1^F) \geq 0$$

Solving for the optimization problem using Karush–Kuhn–Tucker conditions, we know the profit is maximized at the higher bound for w_1, which happens when we have $B_1 = 0$ binding. The equilibrium w_1^* satisfies the following equation.

$$p_1^* w_1^* + \int_{w_1^*}^{\infty} \frac{1}{\sigma} \phi(\frac{\ln t - \mu}{\sigma})\, dt + (1 - p_1^*)\rho i_1^* = \mu_0$$

Plugging this value into the equation for $\tilde{i_1}$, we solve for $i_1^* = p_1^* r$. As long as there is a solution to the wage equation above, we know that it satisfies $E(\pi_1^F) \geq 0$ and there will be a contract. Thus when $r < \rho$, a non-compete agreement will be used.

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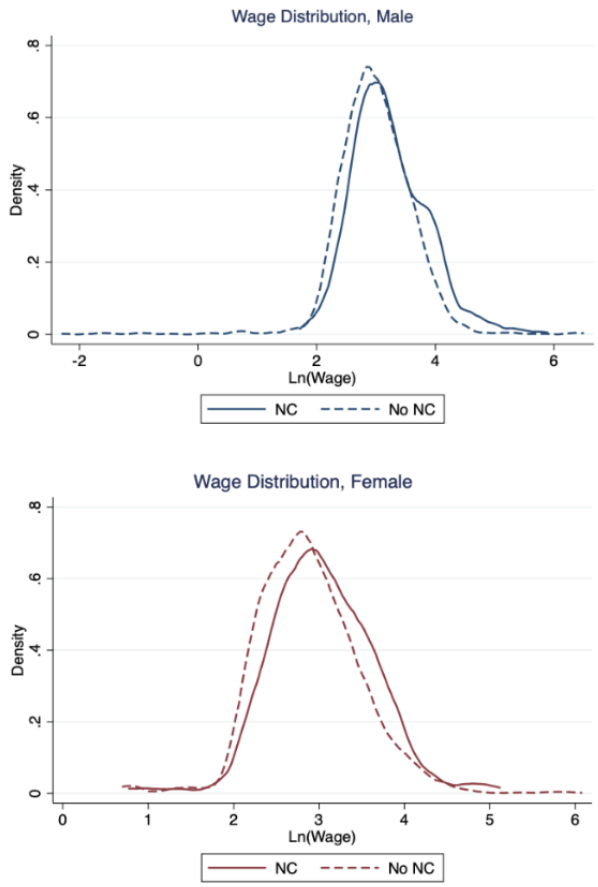


Figure 4: The sample consists of respondents in the NLSY97 that report non-compete status and the wage of their main job in 2017. The (log) wage is measured by dollars earned per hour.

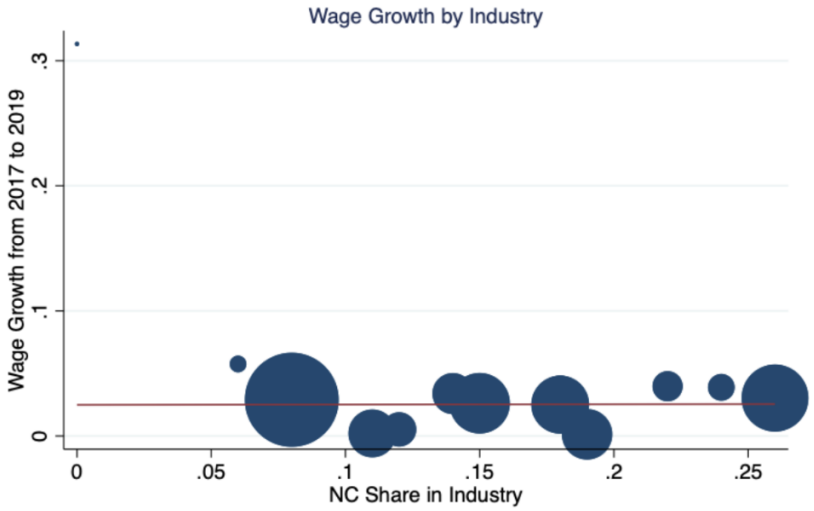


Figure 5: The sample includes respondents with valid NC status in 2017 and valid wage information in 2017 and 2019. The figure presents the mean wage change among all respondents between 2017 and 2019 by industry. The line of best fit is weighted by industry size and the size of the circles are proportional to industry size. The wage is measured in terms of dollars earned per hour.

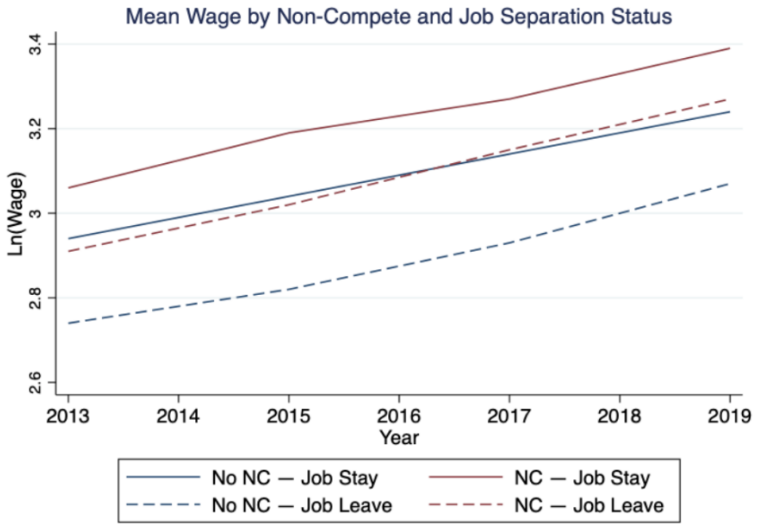
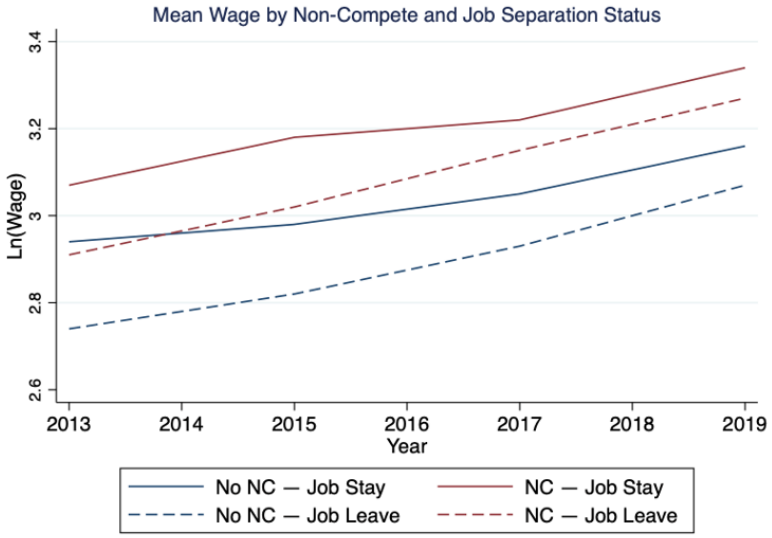
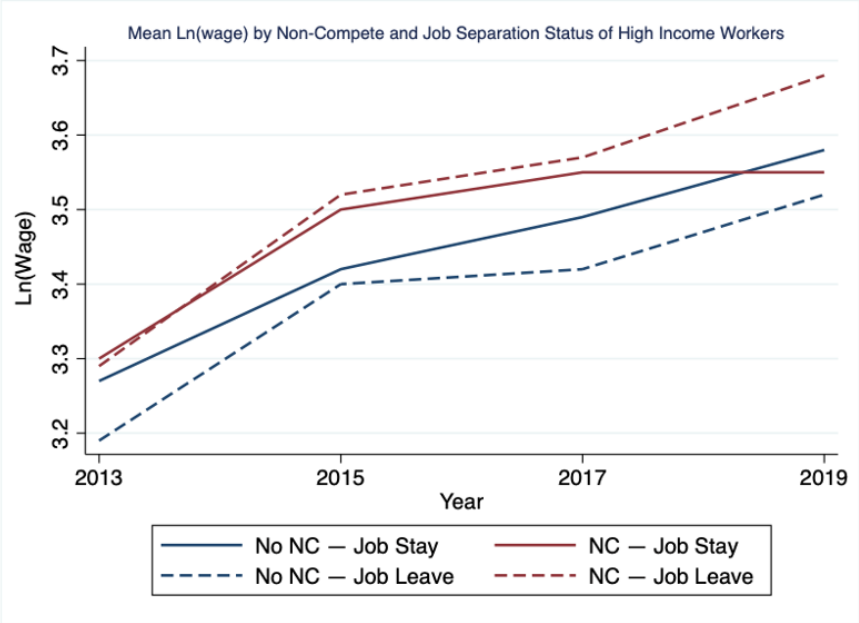


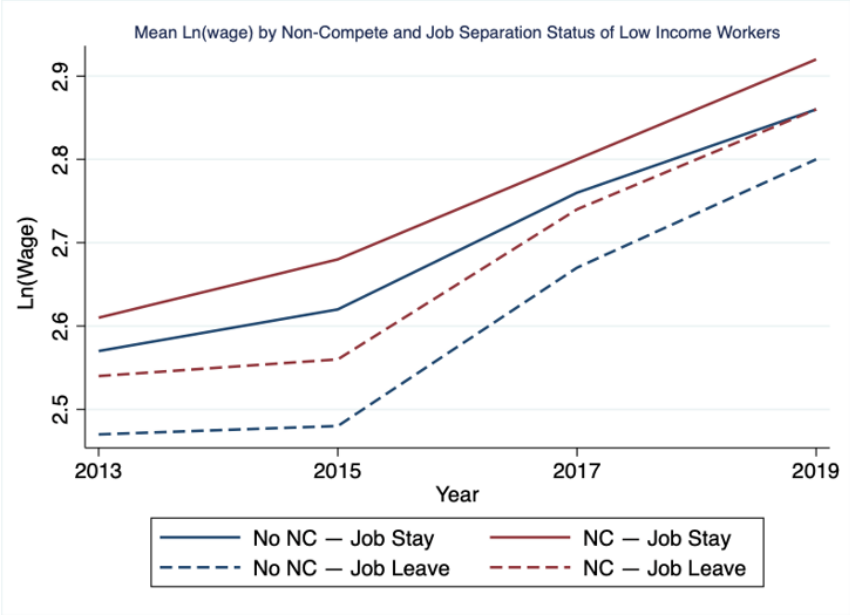
Figure 6: The sample includes respondents with valid NC status in 2017 and valid wage information in all survey years between 2013 and 2019. The graph divides respondents into four groups based on their NC status in 2017 and whether they experienced a job separation between 2013 and 2019. The wage is measured for the main employer and in terms of dollars earned per hour.



Appendix Figure 1: The sample includes respondents with valid NC status in 2017 and valid wage information in all survey years between 2013 and 2019. The graph divides respondents into four groups based on their NC status in 2017 and whether they experienced a job separation between 2017 and 2019. The wage is measured for the main employer and in terms of dollars earned per hour.



Appendix Figure 2: The sample of this graph includes respondents earning above-median wages in 2015, who had valid NC status in 2017, valid wage information from 2013, 2015, 2017, and 2019, and valid job separation information from 2013, 2015, 2017, and 2019. 654 people in the sample did not have NC and job separation, 137 had NC but no job separation, 1513 did not have NC but separated jobs, and 324 had NC and separated jobs. The wage variable is measured by dollars earned per hour. The graph divides respondents into four groups by their NC status in 2017 and whether they had separated a job between 2013 and 2019. For respondents staying in the same job, the mean wage represents the average wage received from their main employer; for respondents that had a job separation from 2013 to 2019, the mean wage represents the average wage received from their main employers.



Appendix Figure 3: The sample of this graph includes respondents earning below-median wages in 2015, who had valid NC status in 2017, valid wage information from 2013, 2015, 2017, and 2019, and valid job separation information from 2013, 2015, 2017, and 2019. 568 people in the sample did not have NC and job separation, 84 had NC but no job separation, 2425 did not have NC but separated jobs, and 331 had NC and separated jobs. The wage variable is measured by dollars earned per hour. The graph divides respondents into four groups by their NC status in 2017 and whether they had separated a job between 2013 and 2019. For respondents staying in the same job, the mean wage represents the average wage received from their main employer; for respondents that had a job separation from 2013 to 2019, the mean wage represents the average wage received from their main employers.

Table 1: Usage of Non-Compete Agreements by Industry

	NC Status			
Industry	**Yes**	**No**	**Total**	**Share**
PROFESSIONAL AND RELATED SERVICES	130	408	538	0.24
WHOLESALE TRADE	24	81	105	0.23
ACS SPECIAL CODES	30	119	149	0.20
MINING	5	20	25	0.20
FINANCE, INSURANCE, AND REAL ESTATE	63	258	321	0.20
MANUFACTURING	76	350	426	0.18
INFORMATION AND COMMUNICATION	13	65	78	0.17
TRANSPORTATION AND WAREHOUSING	34	196	230	0.15
OTHER SERVICES	20	121	141	0.14
RETAIL TRADE	54	346	400	0.14
CONSTRUCTION	31	243	274	0.11
ENTERTAINMENT, ACCOMODATIONS, AND FOOD SERVICES	33	325	358	0.09
PUBLIC ADMINISTRATION	22	221	243	0.09
EDUCATIONAL, HEALTH, AND SOCIAL SERVICES	93	998	1091	0.09
UTILITIES	2	28	30	0.07
AGRICULTURE, FORESTRY AND FISHERIES	2	29	31	0.06
ACTIVE DUTY MILITARY		1	1	0
Total	632	3809	4441	0.14

Note: The sample consists of respondents in the NLSY97 that report non-compete status and industry of their main job in 2017.

Table 2: Respondent Characteristics by Non-Compete Status

	NC	No NC	Difference	P-Value
Tenure				
Tenure	5.16	4.95	0.21	0.00
1 (Job Separation)	0.06	0.10	-0.04	0.30
Wage				
Starting Wage	20.73	16.60	4.13	0.00
Wage in 2017	28.90	22.97	5.93	0.00
Wage in 2019	32.95	25.61	7.34	0.00
Wage Growth 2015-2017	0.04	0.04	0.00	0.99
Wage Growth 2017-2019	0.03	0.02	0.00	0.95
Employer-Paid Training				
Run by Employer	0.31	0.27	0.05	0.01
Run by Third Party at Work	0.12	0.10	0.02	0.15
Other Training	0.29	0.24	0.06	0.00
Demographic				
Age	34.30	34.26	0.04	0.34
Experience	14.64	14.20	0.44	0.00
1 (Male)	0.56	0.48	0.08	0.06
1 (High School)	0.87	0.83	0.04	0.34
1 (4-Year College)	0.47	0.37	0.10	0.02
Sample Size	715	4302		

Note:
The sample includes respondents with valid 2017 NC status, tenure and job separation status in 2017, wage information from 2015 to 2019, and employer-sponsored training information in 2017, restricted to their main jobs in 2017. Information about respondents' main job in 2017 are derived from the NLSY97. Tenure, measured in years working for the main employer in 2017, are calculated from the number of weeks working for the employer. Education is calculated from the number of years in school. The job separation rate (whether the respondent leaves their main job in 2017 before being interviewed in 2017) derived from the interview date in 2017 and the end date of the main job. All the wage variables are measured in dollars earned per hour, and the experience variable is measured as potential working experience. Potential Experience = Age - Highest Education Grade - 6. The training variables present the percentage (in decimal form) of people that have ever received employer-run training in their main job in 2017. Raw means and p-values from a two-sided t-test are reported.

Table 3: Employer Sponsored Training by Non-Compete Status

	Formal Company Training Run by Employer				Training Program at Work Run by Someone Other Than Employer				Other Training			
	Nc	No NC	Difference	P-Value	NC	No NC	Difference	P-Value	NC	No NC	Difference	P-Value
High NC Share Industries	0.33	0.26	0.07	0	0.13	0.10	0.03	0.05	0.3	0.22	0.08	0.00
Low NC Share Industries	0.26	0.27	-0.01	0.76	0.11	0.11	0.00	0.95	0.26	0.25	0.01	0.74
High Wage Earners	0.37	0.32	0.05	0.05	0.16	0.14	0.02	0.24	0.39	0.31	0.07	0.00
Low Wage Earners	0.20	0.21	-0.01	0.71	0.06	0.07	0.01	0.52	0.14	0.16	-0.02	0.39
High NC Use Occupation	0.30	0.28	0.02	0.56	0.07	0.09	-0.02	0.49	0.27	0.18	0.09	0.01
Low NC Use Occupation	0.32	0.26	0.06	0.01	0.14	0.11	0.03	0.05	0.3	0.25	0.05	0.03

Note: The sample of this table includes workers reporting valid information on NC status, training, wage, industry and occupation in 2017. "High" and "Low" classifications use median values in 2017 as a cutoff. The training variables present the percentage (in decimal form) of people that have ever received training in their main job in 2017. Raw means and p-values from a two-sided t-test are reported.

Table 4: Mean Wage Growth from 2017 to 2019 by Income Status and NC Status

Income Status	NC	No NC	Difference	P-Values
High Income (>= Median)	0.02	0.02	-0.00	0.98
Low Income (< Median)	0.03	0.03	0.00	0.97
Total	0.03	0.03	0.00	0.98

Note: The sample includes respondents in the NLSY97 with valid NC status in 2017 and wage information of their main job in 2015, 2017, and 2019. The high-income group includes respondents receiving above-median wages in 2015, and the low-income group contains respondents with below-median wages in 2015. The wage is measured in dollars earned per hour.

Table 5: Effects of Non-Compete Agreements on Labor Market Outcomes

Dependent Variables:	Wage Growth	Hourly Wages	Tenure	1(Job Separation)	1(On the Job Training)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
$1(NC_{2017})$	-0.032	4.802**	1.720***	-0.691***	-0.137
	(0.03)	(2.24)	(0.42)	(0.03)	(0.09)
$1(NC_{2017}) \times$ Year = 2013	0.018	1.656	-0.142	-0.114***	0.041
	(0.02)	(1.16)	(0.19)	(0.02)	(0.03)
$1(NC_{2017}) \times$ Year = 2015	-0.003	1.658*	-0.114	-0.062***	0.030*
	(0.02)	(0.75)	(0.14)	(0.01)	(0.02)
$1(NC_{2017}) \times$ Year = 2019	0.00	1.780**	2.550***	-0.234***	0.009
	(0.00)	(0.85)	(0.13)	(0.02)	(0.02)
Constant	0.143***	24.234***	3.466***	0.976***	0.572***
	(0.02)	(1.98)	(0.39)	(0.02)	(0.09)
Fit statistics					
Observations	1456	2005	2057	1864	2071
R-Squared	0.001	0.004	0.080	0.251	0.003

Clustered (individual) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

The sample restricts to an unbalanced panel of respondents that have non-compete agreements either in 2017 or in 2019. The time period covered is 2013 - 2019, with reported effects relative to the 2017 baseline. Respondents who report having non-compete agreements in 2019 are new job holders. Standard errors are clustered at the individual level. Treated individuals have non-compete agreements in 2017. Wage growth in period t is measured as $Log(Wages_{t+1}) - Log(Wages_t)$.

Table A1: Uncertainty and Confidence by Industry

	NC Status		
Industry	Don't Know	Total	Share
AGRICULTURE, FORESTRY AND FISHERIES	22	53	0.42
MINING	2	27	0.07
UTILITIES		30	0.00
CONSTRUCTION	117	391	0.30
MANUFACTURING	53	479	0.11
WHOLESALE TRADE	26	131	0.20
RETAIL TRADE	102	502	0.20
TRANSPORTATION AND WAREHOUSING	66	296	0.22
INFORMATION AND COMMUNICATION	32	110	0.29
FINANCE, INSURANCE, AND REAL ESTATE	89	410	0.22
PROFESSIONAL AND RELATED SERVICES	244	782	0.31
EDUCATIONAL, HEALTH, AND SOCIAL SERVICES	154	1245	0.12
ENTERTAINMENT, ACCOMODATIONS, AND FOOD SERVICES	137	495	0.28
OTHER SERVICES	142	283	0.50
PUBLIC ADMINISTRATION	13	256	0.05
ACTIVE DUTY MILITARY	13	14	0.93
ACS SPECIAL CODES	25	174	0.14
Total	1,237	5,678	0.22

Note: The sample of this table includes respondents with non-missing NC status and industry information on their main job in 2017.

Table A2: Usage of Non-Compete Agreements by Sector

Sector	NC Status		
	NC	No NC	Total
Government	20	201	221
Private for-profit company	211	1,231	1,442
Non-profit organization (including tax exempt and charitable)	13	150	163
Working WITHOUT PAY in a family business or farm	1	6	7
Total	245	1,588	1,833

Note: The sample includes respondents with valid NC status and sector information of their main job in 2017.

Table A3: Non-Compete Usage in 2019 By Industry

Industry	NC	No NC	Share within Industry	Share within NC Group
AGRICULTURE, FORESTRY AND FISHERIES	0	11	0.00	0.00
MINING	2	20	0.09	0.01
UTILITIES	3	14	0.18	0.01
CONSTRUCTION	17	164	0.09	0.06
MANUFACTURING	41	215	0.16	0.13
WHOLESALE TRADE	19	51	0.27	0.06
RETAIL TRADE	23	260	0.08	0.07
TRANSPORTATION AND WAREHOUSING	19	139	0.12	0.06
INFORMATION AND COMMUNICATION	3	37	0.08	0.01
FINANCE, INSURANCE, AND REAL ESTATE	25	107	0.19	0.08
PROFESSIONAL AND RELATED SERVICES	62	253	0.20	0.20
EDUCATIONAL, HEALTH, AND SOCIAL SERVICES	56	561	0.09	0.18
ENTERTAINMENT, ACCOMODATIONS, AND FOOD SERVICES	23	315	0.07	0.07
OTHER SERVICES	13	80	0.14	0.04
PUBLIC ADMINISTRATION	3	71	0.04	0.01
ACS SPECIAL CODES	0	5	0.00	0.00
Total	309	2303	0.12	1.00

Note: The sample consists of respondents in the NLSY97 that report non-compete status and industry of their main job in 2019. Non-compete status is only reported for new job holders.

Table A4: Relationship between Non-Compete Agreements and Log(Wages) in 2019

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6 (Industry Controls)
1(NC)	0.281***	0.274***	0.273***	0.261***	0.235***	0.187***
	(0.0391)	(0.0392)	(0.0391)	(0.0388)	(0.0367)	(0.0357)
Tenure		0.0436***	0.0432***	0.0415***	0.0688***	0.0539***
		(0.00775)	(0.00775)	(0.00783)	(0.00835)	(0.00713)
Age			0.0117	0.0128	-0.00796	-0.00492
			(0.00877)	(0.00873)	(0.00842)	(0.00764)
Male				0.166***	0.147***	0.151***
				(0.0253)	(0.0244)	(0.0252)
Pot. Exp					0.0354***	0.0270***
					(0.00242)	(0.00229)
Constant	2.797***	2.752***	2.331***	2.211***	2.465***	2.488***
	(0.0134)	(0.0166)	(0.318)	(0.319)	(0.304)	(0.278)
Mean Ln(Wage)	3.000	3.000	3.000	3.000	3.000	3.000
Observations	2,572	2,512	2,512	2,512	2,512	2,468
R-squared	0.020	0.030	0.031	0.047	0.126	0.278

Notes: The sample restricts to a cross-section of respondents that report non-compete status in 2019. Respondents who report non-compete status in 2019 did not have the same job in 2017. Potential experience is measured as (Age - Education - 6).
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Non-Compete Agreements and Wage Growth Between 2017 and 2019

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6 (Industry Controls)
1(NC)	0.003	0.003	0.003	0.003	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
Tenure		0.001	0.001	0.001	0.001	0.001
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age			-0.003	-0.003	-0.002	-0.003
			(0.003)	(0.003)	(0.002)	(0.003)
Male				-0.001	-0.001	0.002
				(0.005)	(0.005)	(0.004)
Pot Exp					-0.001	-0.001
					(0.001)	(0.001)
Constant	0.0249***	0.0207***	0.130	0.130	0.122	0.124
	(0.003)	(0.005)	(0.086)	(0.088)	(0.084)	(0.087)
Mean Wage Growth	0.026	0.026	0.026	0.026	0.026	0.026
Observations	3,949	3,904	3,904	3,904	3,904	3,845
R-squared	0.000	0.001	0.002	0.002	0.002	0.007

Note: The sample restricts to respondents who report non-compete status in 2017 and wages in 2017 and 2019. Potential experience is measured as (Age - Education - 6). Robust standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A6: Relationships between Non-Compete Agreements and Labor Market Outcomes – Full-Sample

Dependent Variables: Model:	Wage Growth (1)	Hourly Wages (2)	Tenure (3)	1(Job Separation) (4)	1(On the Job Training) (5)
Variables					
$1(NC_{2017})$	-0.004	4.793**	-0.481***	0.085***	0.042
	(0.01)	(1.11)	(0.18)	(0.02)	(0.03)
$1(NC_{2017}) \times$ Year = 2013	0.018	1.656	-0.142	-0.114***	0.041
	(0.02)	(1.16)	(0.19)	(0.02)	(0.03)
$1(NC_{2017}) \times$ Year = 2015	-0.003	1.658*	-0.114	-0.062***	0.030*
	(0.02)	(0.75)	(0.14)	(0.01)	(0.02)
$1(NC_{2017}) \times$ Year = 2019	0.00	1.780**	2.550***	-0.234***	0.009
	(0.00)	(0.85)	(0.13)	(0.02)	(0.02)
Constant	0.107***	24.243***	5.666***	0.200***	0.394***
	(0.02)	(1.98)	(0.39)	(0.02)	(0.09)
Fit statistics					
Observations	8853	12558	12836	11530	13004
R-Squared	0.000	0.007	0.009	0.008	0.001

Clustered (individual) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

The sample restricts to an unbalanced panel of respondents, where treated individuals have non-compete agreements in 2017. The time period covered is 2013 - 2019, with reported effects relative to the 2017 baseline. Standard errors are clustered at the individual level. Wage growth in period t is measured as $Log(Wages_{t+1}) - Log(Wages_t)$.

Table A7: Employer Sponsored Training by Industry and Non-Compete Status

	Formal Company Training Run by Employer				Training Program at Work Run by Someone Other Than Employer				Other Training			
Industry	Nc	No NC	Difference	P-Value	NC	No NC	Difference	P-Value	NC	No NC	Difference	P-Value
AGRICULTURE, FORESTRY AND FISHERIES	0.50	0.10	0.40	0.10	0.00	0.10	-0.10	0.64	0.50	0.13	0.37	0.17
MININGs	0.50	0.29	0.21	0.33	0.33	0.14	0.19	0.29	0.50	0.24	0.26	0.22
UTILITIES	0.00	0.21	-0.21	0.38	0.00	0.07	-0.07	0.64	0.33	0.45	-0.11	0.70
CONSTRUCTION	0.12	0.21	-0.09	0.22	0.03	0.08	-0.05	0.32	0.21	0.27	-0.06	0.45
MANUFACTURING	0.28	0.19	0.09	0.06	0.13	0.08	0.05	0.13	0.29	0.21	0.08	0.10
WHOLESALE TRADE	0.32	0.27	0.05	0.60	0.12	0.11	0.01	0.90	0.16	0.19	-0.03	0.74
RETAIL TRADE	0.24	0.20	0.04	0.45	0.06	0.04	0.02	0.56	0.17	0.14	0.03	0.48
TRANSPORTATION AND WAREHOUSING	0.23	0.29	-0.07	0.45	0.13	0.08	0.04	0.43	0.13	0.21	-0.08	0.31
INFORMATION AND COMMUNICATION	0.43	0.31	0.12	0.31	0.05	0.12	-0.07	0.35	0.24	0.21	0.03	0.75
FINANCE, INSURANCE, AND REAL ESTATE	0.44	0.38	0.06	0.38	0.19	0.14	0.05	0.37	0.52	0.31	0.22	0.00
PROFESSIONAL AND RELATED SERVICES	0.36	0.27	0.09	0.03	0.15	0.11	0.03	0.27	0.29	0.23	0.07	0.09
EDUCATIONAL, HEALTH, AND SOCIAL SERVICES	0.26	0.28	-0.02	0.70	0.13	0.12	0.01	0.74	0.24	0.24	0.01	0.90
ENTERTAINMENT, ACCOMODATIONS, AND FOOD SERVICES	0.19	0.19	0.00	0.95	0.05	0.06	0.00	0.97	0.16	0.15	0.02	0.78
OTHER SERVICES	0.22	0.17	0.06	0.55	0.06	0.08	-0.02	0.76	0.28	0.20	0.07	0.47
PUBLIC ADMINISTRATION	0.65	0.49	0.16	0.16	0.25	0.20	0.05	0.57	0.60	0.47	0.13	0.26
ACS SPECIAL CODES	0.42	0.40	0.02	0.81	0.08	0.15	-0.07	0.29	0.47	0.35	0.12	0.18
Total	0.31	0.27	0.05	0.01	0.12	0.10	0.02	0.15	0.29	0.24	0.05	0.00

Note: The sample of this table includes youth workers reporting valid NC status and training information in 2017. The training variables present the percentage (in decimal form) of people that have ever received employer-run training in their main job in 2017. Raw means and p-values from a two-sided t-test are reported.

Additional Appendices: Training and Job Separation in Imperfect Labor Markets: The Case of Non-Compete Agreements

Bhargav Gopal and Xiangru Li

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A Monopsonistic Model

We make several changes to develop a monopsonistic model that may better reflect the dynamics with non-compete agreements for low wage workers. First and foremost, we assume that there are many workers of different initial outside options, instead of one worker with a fixed outside option. Workers' first period outside options, denoted as μ_0^j, with j indicating different workers, are distributed log normally with mean η and variance σ^2. The firm can only choose one wage, which will determine the level of employment, in order to maximize its expected profit. We additionally assume that investment is exogenous to simplify the model.

First, we solve the social planner's problem. The social planner in this case determines the efficient level of employment. In the last period, it is efficient to trade if and only if $v \leq (r-\rho)i$. Denote the probability that trading is efficient as p_s. In the first stage, the planner matches workers to the monopsonistic firm only if the expected surplus from the match is greater than the worker's ex-ante outside option. We denote the efficient employment level as $q_s = P(E(S) \geq \mu_0^j)$, where

$$E(S) = -c(i) + p_s ri + (1-p_s)\rho i + \int_{(r-\rho)i}^{\infty} \frac{1}{\sigma}\phi(\frac{\ln t - \mu}{\sigma})\,dt$$

Now we solve the firm's decisions. In the last period, the worker will not quit so long as $w_\delta \geq v + \rho i(1-\delta)$. We denote the probability of trade as p_δ, which does not depend on the identity of the worker. Now in the first period, the firm chooses the wage to maximize its profit. Given a wage w_δ, we denote the proportion of workers agreeing to the contract as $q_\delta = P(E(\pi_\delta^W) \geq \mu_0^j)$. Thus, the firm chooses the wage that maximizes the following equation:

$$E(\pi_\delta^F) = q_\delta[-c(i) + p_\delta(ri - w_\delta)]$$

Proposition A1: Employment without a non-compete agreement is less than the socially efficient level ($q_0 \leq q_s$).

Proof. Given that $q_0 = P(E(\pi_0^W) \geq \mu_0^j)$ and $q_s = P(E(S) \geq \mu_0^j)$, we only need to show that $E(\pi_0^W) \leq E(S)$ in order to prove $q_0 \leq q_s$.

$$E(\pi_0^W) = p_0^* \cdot w_0^* + (1-p_0^*)\rho i + \int_{w_0^*-\rho i}^{\infty} \frac{1}{\sigma}\phi(\frac{\ln t - \mu}{\sigma})\,dt$$

In any contract, we know $w_0^* \leq ri$, since the firm must earn non-negative profits ex-post. Thus $w_0 - \rho i \leq (r-\rho)i$, which means $p_0^* \leq p_s^*$. In addition, the firm chooses wages so that it earns non-negative profits ex-post: $-c(i) + p_0(ri - w_0) \geq 0$.

Now we can compare $E(S)$ with $E(\pi_0^W)$.

$$\begin{aligned}
E(S) - E(\pi_0^W) &= -c(i) + p_s ri - p_0 w_0 - (p_s - p_0)\rho i - \int_{w_0^*-\rho i}^{(r-\rho)i} \frac{1}{\sigma}\phi(\frac{\ln t - \mu}{\sigma})\,dt \\
&= \overbrace{-c(i) + p_0(ri - w_0)}^{\geq 0} + (p_s - p_0)(r-\rho)i - (p_s - p_0)E(v \mid v \in [w_0^* - \rho i, (r-\rho)i]) \\
&\geq \overbrace{(p_s - p_0)}^{\geq 0}[(r-\rho)i - \overbrace{E(v \mid v \in [w_0^* - \rho i, (r-\rho)i])}^{\leq (r-\rho)i}] \\
&\geq 0
\end{aligned}$$

Proposition A2: The effect of non-compete agreements on wages is theoretically ambiguous.

Proof. When $\delta = 0$, take FOC we have

$$\frac{dq_0^*}{dw_0^*} \cdot [-c(i) + p_0^*(ri - w_0^*)] + q_0^* \cdot [\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*] = 0 \tag{7}$$

Now to compare the wage with and without a non-compete, like in Proposition 3, we only need to check $\frac{dw_0^*}{d\rho}$. From the equation above, we can take total derivative in terms of q and assuming that $\frac{d^2 q_0^*}{dw_0^* d\rho} \approx 0$ we get

$$\frac{dq_0^*}{dw_0^*} \cdot [\frac{dp_0^*}{d\rho} \cdot (ri - w_0^*) - p_0^* \cdot \frac{dw_0^*}{d\rho}] + \frac{dq_0^*}{d\rho} \cdot [\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*] + q_0^* \cdot [-\frac{dp_0^*}{dw_0^*} \cdot \frac{dw_0^*}{d\rho} - \frac{dp_0^*}{d\rho}] = 0$$

$$\text{where } \frac{dp_0^*}{d\rho} = \frac{\partial p_0^*}{\partial \rho} + \frac{dp_0^*}{dw_0^*} \cdot \frac{dw_0^*}{d\rho} \text{ and } \frac{dq_0^*}{d\rho} = \frac{dq_0^*}{dw_0^*} \cdot \frac{dw_0^*}{d\rho} + \frac{\partial q_0^*}{\partial \rho}$$

$$\implies 2[\frac{dq_0^*}{dw_0^*} \cdot (\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*) - q_0^* \cdot \frac{dp_0^*}{dw_0^*})]\frac{dw_0^*}{d\rho} = \frac{\partial p_0^*}{\partial \rho} \cdot [q_0^* - \frac{dq_0^*}{dw_0^*} \cdot (ri - w_0^*)] - \frac{\partial q_0^*}{\partial \rho}[\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*] \tag{8}$$

From equation 1 above, since we have

$$\overbrace{\frac{dq_0^*}{dw_0^*} \cdot [-c(i) + p_0^*(ri - w_0^*)]}^{\geq 0} + \overbrace{q_0^*}^{\geq 0} \cdot [\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*] = 0 \tag{9}$$

$$\implies \frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^* \leq 0$$

Thus from equation 2 we have

$$\overbrace{2[\frac{dq_0^*}{dw_0^*} \cdot (\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*) - q_0^* \cdot \frac{dp_0^*}{dw_0^*})]}^{\leq 0}\frac{dw_0^*}{d\rho} = \overbrace{\frac{\partial p_0^*}{\partial \rho}}^{<0} \cdot [q_0^* - \frac{dq_0^*}{dw_0^*} \cdot (ri - w_0^*)] - \frac{\partial q_0^*}{\partial \rho}\overbrace{[\frac{dp_0^*}{dw_0^*}(ri - w_0^*) - p_0^*]}^{\leq 0} \tag{10}$$

It is unclear whether w_0^* increases with ρ or not without knowing more about the distributions of q_0 and p_0. If $\frac{dw_0^*}{d\rho} > 0$, then we know that the wage is higher without a non-compete agreement.

Cross-Sectional Relationship between Non-Compete Agreements and Wages in 2017

	(1)	(2)	(3)	(4)	(5)	(6)
NC	0.215***	0.206***	0.206***	0.197***	0.185***	0.161***
	(0.026)	(0.026)	(0.026)	(0.025)	(0.025)	(0.024)
Tenure		0.028***	0.027***	0.027***	0.017***	0.017***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age			0.009	0.009	-0.016**	-0.0131**
			(0.006)	(0.006)	(0.006)	(0.006)
Male				0.110***	0.093***	0.113***
				(0.018)	(0.018)	(0.020)
Potential Experience					0.036***	0.031***
					(0.003)	(0.003)
Constant	2.937***	2.803***	2.500***	2.439***	2.834***	2.816***
	(0.010)	(0.014)	(0.206)	(0.205)	(0.203)	(0.195)
Industry Effects	-	-	-	-	-	Yes
Observations	4,746	4,677	4,677	4,677	4,677	4,677
R-squared	0.015	0.055	0.055	0.063	0.112	0.205
Mean	2.97	2.97	2.97	2.97	2.97	2.97

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes: The sample includes respondents with valid 2017 NC status, tenure, and industry information, restricted to their main jobs in 2017. All the wage variables are measured in dollars earned per hour, and the experience variable is measured as potential working experience: Potential experience = Age - Highest Education Grade - 6.

Cross-Sectional Relationship between Non-Compete Agreements and Wage Percentile in 2017

	(1)	(2)	(3)	(4)	(5)	(6)
NC	0.094***	0.089***	0.089***	0.084***	0.078***	0.069***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
Tenure		0.015***	0.015***	0.015***	0.009***	0.009***
		(0.001)	(0.000873)	(0.001)	(0.001)	(0.001)
Age			0.003	0.003	-0.010***	-0.009***
			(0.003)	(0.003)	(0.003)	(0.003)
Male				0.060***	0.052***	0.057***
				(0.008)	(0.008)	(0.00796)
Potential Experience					0.019***	0.016***
					(0.001)	(0.001)
Constant	0.490***	0.417***	0.327***	0.294***	0.498***	0.486***
	(0.004)	(0.006)	(0.091)	(0.091)	(0.088)	(0.082)
Industry Effects	-	-	-	-	-	Yes
Observations	4,746	4,677	4,677	4,677	4,677	4,677
R-squared	0.014	0.074	0.074	0.086	0.150	0.257
Mean	0.50	0.50	0.50	0.50	0.50	0.50

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes: The sample includes respondents with valid 2017 NC status, tenure, and industry information, restricted to their main jobs in 2017. All the wage variables are measured in dollars earned per hour, and the experience variable is measured as potential working experience: Potential experience = Age - Highest Education Grade - 6.

Cross-Sectional Relationship between Non-Compete Agreements and Wages in 2019

	(1)	(2)	(3)	(4)	(5)	(6)
NC	0.285***	0.278***	0.278***	0.265***	0.236***	0.206***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.044)	(0.042)
Tenure		0.038***	0.038***	0.036***	0.063***	0.052***
		(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
Age			0.011	0.013	-0.012	-0.008
			(0.011)	(0.011)	(0.010)	(0.009)
Male				0.198***	0.170***	0.172***
				(0.031)	(0.030)	(0.032)
Potential experience					0.040***	0.031***
					(0.003)	(0.003)
Constant	2.852***	2.812***	2.429***	2.241***	2.582***	2.584***
	(0.017)	(0.021)	(0.384)	(0.384)	(0.366)	(0.336)
Industry Effects	-	-	-	-	-	Yes
Observations	1,661	1,641	1,641	1,641	1,641	1,641
R-squared	0.023	0.031	0.032	0.055	0.148	0.273
Mean	3.08	3.08	3.08	3.08	3.08	3.08

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes: The sample includes respondents with valid 2019 NC status, tenure, wage and industry information, restricted to their main jobs in 2019. All the wage variables are measured in dollars earned per hour, and the experience variable is measured as potential working experience: Potential experience = Age - Highest Education Grade - 6.

Cross-Sectional Relationship between Non-Compete Agreements and Wage Percentile in 2019

	(1)	(2)	(3)	(4)	(5)	(6)
NC	0.127***	0.123***	0.123***	0.117***	0.103***	0.094***
	(0.020)	(0.021)	(0.021)	(0.020)	(0.019)	(0.019)
Tenure		0.020***	0.020***	0.019***	0.032***	0.028***
		(0.004)	(0.004)	(0.005)	(0.005)	(0.004)
Age			0.000	0.001	-0.011**	-0.009**
			(0.005)	(0.005)	(0.004)	(0.004)
Male				0.104***	0.091***	0.091***
				(0.014)	(0.013)	(0.013)
Potential experience					0.020***	0.017***
					(0.001)	(0.001)
Constant	0.394***	0.372***	0.371**	0.272	0.440***	0.430***
	(0.007)	(0.009)	(0.171)	(0.170)	(0.159)	(0.148)
Industry Effects	-	-	-	-	-	Yes
Observations	1,661	1,641	1,641	1,641	1,641	1,641
R-squared	0.023	0.035	0.035	0.069	0.185	0.273
Mean	0.50	0.50	0.50	0.50	0.50	0.50

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Notes: The sample includes respondents with valid 2019 NC status, tenure, wage and industry information, restricted to their main jobs in 2019. All the wage variables are measured in dollars earned per hour, and the experience variable is measured as potential working experience: Potential experience = Age - Highest Education Grade - 6.