Do Non-Compete Agreements Help or Hurt Workers? Evidence from the NLSY97

Bhargav Gopal [*] Xiangru Li [†] Luke Rawling [‡] [§]

Abstract

While non-compete agreements (NCs) are prevalent, the incentives driving their use and their causal effects on workers remain poorly understood. We develop a model with asymmetric information to show that NCs shift the nature of allocative inefficiency by reducing inefficient quits and increasing inefficient retention, while mitigating the canonical hold-up problem. The model predicts that NCs are more likely to be used in industries with high returns on industry-specific investments, and that signers have longer job tenures, higher wages, and receive more firm-provided investment than similar workers without such agreements. To test these predictions, we use panel data from the NLSY97 and a difference-in-differences research design to estimate the causal impact of signing an NC. We find that NCs raise job tenures by 6% and lead to an immediate wage increase of 10%. Six years after signing, the wage premium falls to 5%. There is also substantial heterogeneity across worker demographics, with non-White, non-college and lower-wage workers experiencing lower wage-growth after signing an NC. While the theory links NCs to firm investment, we find no evidence of increased investment in formal training, suggesting investments prompted by the agreement are likely informal. Our findings caution against blanket bans on non-compete usage, favoring a more targeted approach focusing on lower-wage workers.

[*] Corresponding Author: Smith School of Business at Queen's University. Email: b.gopal@queensu.ca

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

[‡] Department of Economics, Queen's University. Email: luke.rawling@queensu.ca

[§] We are grateful to Sandra Black, Bentley MacLeod, Suresh Naidu, and Bernard Salanié for their guidance. We thank Odeya Leikin for excellent research assistance. We also thank Evan Starr and Robert Clarke for thoughtful comments. Gopal acknowledges funding from the Social Sciences and Humanities Research Council of Canada Grant Number 430-2024-00035.

1 Introduction

The assumption that labor markets are perfectly competitive has been increasingly questioned in recent decades (e.g. Card 2022). One factor that can limit competition is the prevalence of non-compete agreements (NCs), contractual provisions that restrict workers from joining competing firms after leaving their current employer. The impact of NCs on labor markets remains contentious. Proponents argue that NCs increase worker retention and encourage firms to invest in industry-specific training, potentially benefiting workers through higher wages in the long run. Critics argue that NCs create mobility frictions, reducing workers' bargaining power and preventing them from transitioning to firms where they would be more productive.[1]

Despite their widespread use — 15% of U.S. workers were bound by NCs in 2017 — there is limited causal evidence on the effects of signing an NC on long-run individual labor market outcomes. Most empirical studies focus on the effects of non-compete regulation rather than the direct worker-level effects of signing an NC (e.g. Johnson, Lavetti, and Lipsitz 2023; Lipsitz and Starr 2022; Jeffers 2023; Kini, Williams, and Yin 2021). More limited research leveraging micro-data on the usage of NCs has focused on their effects on particular subpopulations such as physicians (Lavetti, Simon, and White 2020), or on the descriptive relationships between signing the agreement and various worker characteristics (Shi 2023; Starr, Prescott, and Bishara 2021). While these studies provide valuable insights into how regulation of NCs affects labor markets and the types of workers who sign NCs, they do not address the fundamental question of whether signing a non-compete helps or harms workers, and for which types of workers. Understanding these worker-level effects is crucial. Do NCs promote long-term gains, such as skill formation and higher earnings? Or do they primarily restrict mobility and suppress wages?

Theoretical research has provided important insights into how NCs affect investment incentives and allocative efficiency, but significant gaps remain. Prior models have explored how NCs encourage firms to invest in general training (e.g. Meccheri 2009; Posner, Triantis, and Triantis 2004; Shy and Stenbacka 2023) and influence the efficient matching between workers and firms (e.g. Shi 2023; Gottfries and Jarosch 2023). However, these theories do not fully explain why workers would voluntarily agree to sign NCs, despite their restrictive nature. If NCs are detrimental to workers, as critics suggest, why do they remain so common? A complete framework must incorporate both firm and worker incentives, explicitly modeling the conditions under which signing an NC is in the interest of both parties.

Our model connects with literature highlighting how contracts affect both investment incen-

[1] Critics also argue that NCs deter business formation by making it difficult for startups to hire skilled workers (e.g., Aghion and Bolton (1987), Jeffers (2023)). Additionally, some firms impose NCs on workers after they have already accepted job offers or without their full awareness, which may allow firms to retain workers at lower wages (Starr, Prescott, and Bishara 2021).

tives and labor market matching. The first strand of literature examines how contracts influence employer investment incentives, particularly when investments are general (e.g., Acemoglu and Pischke 1999; MacLeod and Malcomson 1993). The second focuses on how contracts shape labor market matching efficiency and mobility (e.g., Shi 2023; Gottfries and Jarosch 2023; Pakes and Nitzan 1983). By combining these two perspectives in a single theoretical framework, we formalize the trade-offs arising from using an NC in the employment relationship. We show that NCs reduce inefficient quits, increase inefficient retention (job lock), and encourage firms to provide industry-specific investments.[2] Our model predicts that NCs tend to be most prevalent in industries where firms make substantial investments in industry-specific human capital. At the individual level, the model generates testable predictions that (i) workers who sign NCs should have longer job tenures, higher wages within the firm, and greater employer-sponsored training, but (ii) mobility restrictions may prevent workers from accessing higher-paying external opportunities within the industry.

A key assumption in our model is that workers have private information about their outside options, which prevents contract renegotiation (e.g. Hashimoto 1981; Hart and Moore 1988).[3] Prior work has shown that, in theory, firms could release workers from NCs in exchange for buyout payments (e.g. Shi 2023; Posner, Triantis, and Triantis 2004), potentially restoring the efficient matching between workers and firms in a Coasean world (Coase 1960). Unlike Shi (2023), who focuses on how NCs can generate excessive rent extraction via buyouts, we focus on a distinct inefficiency: the outright prevention of efficient matches when workers cannot be released from binding NCs. At the same time, our model shows that NCs mitigate the hold-up problem by encouraging firms to invest in industry-specific skills. As a modelling extension, we also relax the asymmetric information assumption and allow the worker and firm to renegotiate the original contract. We show that when firms hold all the bargaining power, a contract with an NC implements the social planner's solution. However, even with renegotiation, investment and allocative inefficiencies arise when termination fees are constrained to be common legal remedies such as training repayment fees or expectation damages.

Our theoretical framework provides a lens to understand why NCs are used and function differently across different segments of the labor market. For low-wage workers, whom we model as having lower returns on firm-provided investments and higher discount factors (e.g. Heckman, Lochner, and Todd 2006; Zeldes 1989; Lawrance 1991; Shah, Mullainathan, and Shafir 2012), NCs

[2]Other contract theory models have examined the interplay between investment incentives and matching efficiency in various contexts (e.g. Hellmann and Thiele 2017; MacLeod and Malcomson 1993), but none have explicitly analyzed this trade-off in the specific setting of NCs.

[3]To further elaborate, in our model, the firm cannot verify the terms of the worker's outside offer since it is private information to the worker. As such, the worker cannot command a higher wage by claiming to have a superior outside offer because the firm will anticipate such claims are inflated.

do little to encourage firm investment; instead, low-wage workers may sign the agreement for a minimal compensating wage differential and their primary function is to increase firm profits by reducing costly turnover. In contrast, for skilled professionals, where industry-specific human capital is paramount (e.g. Parent 2000), our model predicts a more productive role for non-competes. By mitigating the hold-up problem, they incentivize firms to invest in valuable industry-specific skills, which can translate into faster wage growth. Finally, for top executives, where investments often involve highly sensitive information (e.g. Kini, Williams, and Yin 2021), our model's extension with renegotiation is most applicable. In this setting, where lawyers can tailor buyout payments to demand conditions, NCs can implement the social planner's outcome by achieving efficient investments and matching between workers and firms. Our analysis cautions against a blanket ban on the enforcement of NCs, as recently proposed by the US Federal Trade Commission and supported by academic research (e.g. Shi 2023). Instead, our framework supports prohibiting such agreements only for low-wage workers, where they may be used and fail to induce substantial firm investment.

To test our theories, we assess the causal impact of signing an NC on various labor market outcomes using data from the National Longitudinal Survey of Youth (NLSY97) and a difference-in-differences research design. The NLSY97 is a nationally representative longitudinal survey that tracks a cohort of individuals who were teenagers in 1997. By 2017, when the survey first includes a question on non-compete status, the sampled individuals are between the ages of 32 and 38 — an ideal period for studying labor market outcomes as respondents are in their prime working years. Of the 5,236 individuals who reported their non-compete status in the 2017 questionnaire, approximately 15% responded affirmatively to having an NC in their contract and more than 90% are "Very Confident" in the accuracy of the response.[4] The NLSY97 includes a wide range of outcome variables, allowing us to assess the effects of NCs on key variables featured in the theoretical model — wages, job mobility, and training — but also on broader aspects of job quality, such as job tasks, job satisfaction, and working hours. The dataset also provides detailed worker characteristics, enabling us to examine heterogeneity across several dimensions, including race, income, gender, education, and cognitive ability.

An advantage of the NLSY97 is that it allows us to track individual workers over time and across jobs, enabling the use of panel data research methods to estimate the causal impact of signing an NC on career trajectories. Unlike prior research using this dataset which has primarily examined non-compete usage in cross-section (Rothstein and Starr 2022), we follow workers across survey waves. Using the panel component of the NLSY97 is critical for several reasons. First,

[4]NLSY97 respondents appear confident in reporting their non-compete status, which contrasts with findings from Cowgill, Freiberg, and Starr (2024). In a field experiment with job applicants for full-time positions at a large U.S. financial services company, they document that many workers fail to notice or recall non-compete clauses in their contracts, particularly when the clause is not made salient at the time of signing. Their results suggest that some workers unknowingly accept NCs.

it allows us to use individual fixed effects to account for time-invariant unobserved heterogeneity across workers who do and do not sign NCs, improving causal identification. Second, it enables us to examine how NCs affect wage growth, rather than cross-sectional wage differences. Third, it allows us to track the effects of signing an NC even if a worker later changes jobs, ensuring that we capture the longer-run impacts of the agreement on labor market outcomes.

Estimating the causal effects of signing an NC is challenging because workers who sign these agreements differ systematically from those who do not. Signing an NC is often coincident with job mobility, which itself is linked to wage increases (i.e. Topel and Ward 1992). Furthermore, in the cross-section, we observe that non-compete signers have characteristics that are associated with higher wages, which complements findings from prior research (i.e. Starr, Prescott, and Bishara 2021). To overcome these challenges, we leverage the fact that different individuals sign NCs at different points in time and compare their individual labor market outcomes to a control group of workers who never sign an NC during the sample period but start jobs in the same year. This approach ensures that we are comparing the trajectories of new job holders (in a given year) with and without an NC rather than workers with fundamentally different labor market experiences. We construct our dataset using NLSY97 data from 2013 to 2021, defining a cohort as a group of individuals who start a new job in a given year. In a given cohort, treated workers are those who begin a job with an NC in that year, while control workers are those who start a job in the same year but never sign an NC over the entire sample period.[5] This setup ensures that for each "experiment," we are comparing newly hired workers with and without NCs, reducing concerns about selection bias.

Following prior work on treatment effects with staggered adoption, we estimate the parameters of a stacked difference-in-differences model, aggregating across cohorts to estimate the average treatment effect of signing an NC (Cengiz et al. 2019; Johnson, Lavetti, and Lipsitz 2023; Gormley and Matsa 2011). By stacking these cohorts together, we construct a series of clean difference-in-differences comparisons, avoiding the issues that arise in standard two-way fixed effects models with staggered treatment timing (Goodman-Bacon 2021; Callaway and Sant'Anna 2021; Sun and Abraham 2021). We are confident in the validity of our causal estimates, as our event-study design reveals no pre-trends for wages, job mobility, or other key outcomes. This finding indicates that

[5] Since the NLSY97 only begins tracking non-compete status in 2017, we assume that if an individual reports signing an NC in 2017, they had it from the beginning of their job tenure. This assumption allows us to estimate the longer-term effects of signing an NC, even though the dataset does not capture NCs from the job's start date. As a sensitivity check, we re-estimate our results using only the 2017, 2019, and 2021 cohorts—workers who started new jobs in those survey waves. For these workers, we directly observe their non-compete agreement status at the time of hiring, eliminating the need for any assumptions about when the agreement was signed. The results from this restricted sample closely align with our main findings, reinforcing the validity of our long-term estimates. If an individual signs multiple NCs over the sample period, the individual is only included in the treated cohort corresponding to the earliest recorded use of the agreement.

workers who go on to sign NCs are not experiencing systematically different trends before signing. To address the primary identification challenge of selection bias, we also use "not-yet-treated" workers as a control group, showing our results are robust when comparing individuals who sign an agreement in a given year to those who will sign one in the future. Moreover, we find no evidence that NC signers are immediately assigned more sophisticated tasks upon signing, suggesting unobserved shocks to worker productivity are not a potential omitted variable. Finally, our conclusions are robust to including a rich set of controls, such as firm size, industry, and occupation, to account for alternative explanations like the possibility that non-compete signers systematically sort into higher-productivity firms.

Our primary empirical finding is that signing an NC leads to a statistically significant and immediate increase in wages. Our stacked event-study estimates indicate that signing an NC raises wages by 9.4% within one year, a magnitude comparable to the returns to an additional year of education (e.g. Card 1999). This wage premium persists for at least six years, though we observe that it declines by approximately 1% per year, consistent with NCs lowering wage growth over time.[6] Notably, the estimated causal wage effect from the quasi-experimental research design (9.4%) is similar in magnitude to the cross-sectional wage premium with controls (8%), suggesting that our cross-sectional wage results are not likely subject to substantial omitted variable bias. We also observe that NCs lower job mobility, as predicted by our theoretical model. On average, NCs increase job tenure by 0.3 years (approximately 6% of the average tenure of 5 years observed in the 2017 cross-section). Despite theoretical predictions that NCs encourage firm-provided training, we find no significant effects on formal measures of employer-provided training. Similarly, we find no significant effects on job satisfaction, working hours, or the nature of job tasks.

We find significant heterogeneity in the effects of NCs across various dimensions, including education, income, and race. For higher-wage, college-educated, and White workers, signing a non-compete is associated with a large and persistent wage premium, reaching as high as 12.4% for those with above-median wages. For this group, the agreement induces an upward-sloping wage-experience profile. This dynamic aligns with a key prediction of our model: NCs can encourage firm-provided investment and raise wage growth. In stark contrast, a markedly different dynamic emerges for lower-wage, non-college-educated, and minority workers. For these groups, an initial wage premium is followed by flatter wage growth over time. This pattern suggests the initial premium functions as a one-time compensating differential for accepting restricted job mobility. For lower-wage workers, our findings align with the model's prediction that NCs primarily serve to reduce turnover and boost firm profits, rather than promote skill formation.

The paper proceeds as follows. Section 2 lays out the theoretical framework. Section 3 dis-

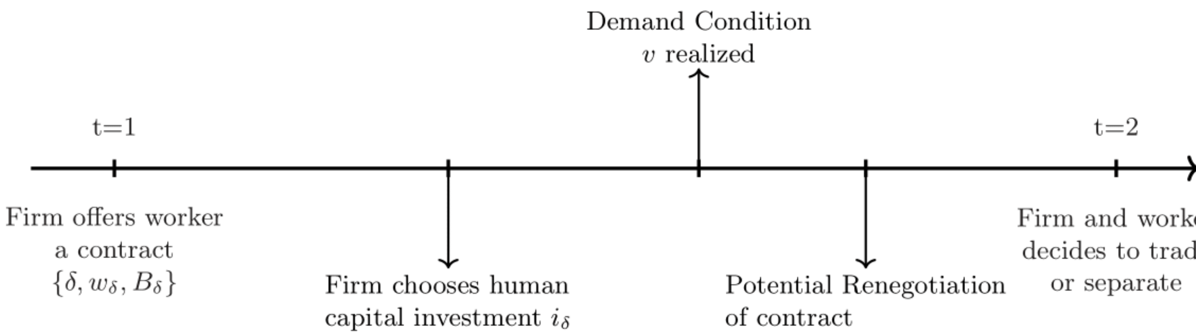
[6]The fact that career earnings remain higher for non-compete signers but that the wage gap narrows over time aligns with the descriptive statistics reported in Shi (2023).

cusses data sources and Section 4 examines the effect of signing an NC on various labor market outcomes. Section 5 concludes.

2 Theoretical Framework

2.1 The Model

Figure 1: Timeline of the Model



We study a two-period model featuring a risk-neutral firm F and a risk-neutral worker W. The worker discounts future compensation by $\beta \leq 1$, while the firm values current and future profits equally. At the beginning of period 1, the firm and worker agree to a contract consisting of a non-compete clause $\delta \in \{0,1\}$, a fixed wage w_δ, and an up-front transfer B_δ from the firm to the worker. Production in the initial period is normalized to zero and we allow the worker to earn initial period wages below marginal product, or $B_\delta < 0$. The non-compete clause restricts the worker, upon separation in period 2, from joining firms in the same industry as F. We initially assume that the contract is rigid: the wage and the non-compete clause cannot be renegotiated in period 2 because of the worker's asymmetric information on his outside option. This assumption prevents the firm from tailoring the employment contract to realized conditions and thus results in inefficient turnover.

Because investment is non-contractible (e.g. Grossman and Hart 1986), once the contract is signed the firm chooses $i_\delta \geq 0$ to maximize its expected profits, incurring a cost of $\frac{1}{2}i_\delta^2$. An additional unit of investment raises the worker's productivity within the firm by r while raising the worker's productivity at industry competitors by ρ. A non-compete agreement prevents the worker from moving to industry competitors; as a result, additional investment by the firm does not raise the worker's outside option when $\delta = 1$.

The firm and worker know the values of r and ρ ex-ante and understand the probability distribution of future outside offers v, but do not observe the realization of v when making the contract or choosing investment. In particular, $v \sim \text{Exponential}(\lambda)$ is drawn at the beginning of period 2 and is privately observed by the worker. We interpret v as the demand for the worker from competing firms, which is private information to the worker, as in Hashimoto (1981). If unrestricted by a non-compete, the worker's outside option is $v + \rho i_0$; if bound by a non-compete, his option remains v.[7] As a result, the non-compete agreement eliminates the worker's access to the within-industry wage premium.

The worker then decides whether to stay at the firm and receive wage w_δ, or to leave and accept the outside offer. Simultaneously, the firm decides whether to retain or fire the worker. If the firm fires the worker, the firm can hire an untrained worker whose marginal product is zero; as a result, the firm will retain the incumbent worker so long as final period wages are less than or equal to marginal product, or $w_\delta \leq r i_\delta$. We remain agnostic about labor market conditions at the time of contracting. The worker has a reservation utility of μ^0 in the initial period that is commonly known to all parties, and will only accept the contract if expected utility exceeds this value. Symmetrically, the firm will only offer a contract if its expected profit is non-negative, which in turn requires the total joint surplus of the relationship to be at least as large as the worker's reservation utility. Throughout our analysis, we assume this condition holds, as no mutually beneficial contract could be formed otherwise.[8] Since the firm acts first, it will choose a contract so that the worker's participation constraint binds.

We allow both r and ρ to vary freely. When $\rho = 0$, investment is purely firm-specific; when $\rho = r$, it is fully transferable across firms in the industry (e.g. Shi 2023). In practice, different sectors exhibit different returns to training, and the external value of a worker's training may vary substantially. Importantly, when $\rho > 0$, the firm's investment benefits not only the firm itself but also the worker by improving his outside option, so the investment is *industry-specific* in nature. This type of investment is common in relational settings and has been analyzed in, for example, Parent (2000). We focus on cases where $r > \rho$, meaning the internal return on investment exceeds the external return. However, the model can also accommodate situations in which a firm's investment increases the worker's productivity more for third parties than for the incumbent firm, as in Pakes and Nitzan (1983). We view this case as particularly applicable to highly skilled scientific personnel, where the value of a discovery made at the original firm may be even greater when developed in a new enterprise or spun out into a separate company.

In standard hold-up models, firms underinvest because they anticipate having to share the additional surplus with workers through a higher wage (i.e. Becker 1962; Acemoglu and Pischke

[7] We assume the labor market is competitive ex-post, so third party firms earn zero profits and all the surplus from the employment relationship is captured either by the incumbent firm or the worker.

[8] Although the model features a single firm, it can represent labor markets with varying degrees of competition ex-ante. For example, in a perfectly competitive labor market, μ^0 should be interpreted as the endogenous utility level which forces firms to offer contracts that yield zero expected profit.

1999). Here, instead, the firm underinvests without an NC due to two reasons. First, the firm does not internalize the benefits to the worker when she leaves for a competitor. Second, the firm's investment raises the worker's outside option and thus the probability of a quit. As a result, the firm captures only a fraction of the marginal social returns to investment and invests sub-optimally.

NCs mitigate this distortion by decoupling investment from the worker's outside option. When $\delta = 1$, the worker's outside option is fixed at v, so increased investment does not raise the probability the worker quits. Furthermore, for any given wage, a worker is less likely to quit with a non-compete than without a non-compete. Both of these forces raise the firm's incentives to invest in industry-specific skills. However, NCs also induce inefficient stays or "job lock." When $v+\rho i_1 > ri_1$ and $w_1 > v$, separation to an industry competitor is socially efficient but the worker is contractually barred from doing so. In these instances, the firm's private returns from investment exceed social returns. As a result, if investment is highly specific (large $r-\rho$), an NC may lead to over-investment relative to the socially optimal level.

2.2 Benchmark Outcomes

2.2.1 The Social Planner's Allocation

To establish an efficiency benchmark, we first characterize the allocation chosen by a social planner who controls both the investment and separation decisions to maximize total social surplus. The planner's problem unfolds in two stages. First, the planner chooses an investment level $i \geq 0$ at a social cost of $\frac{1}{2}i^2$. Second, after the outside option $v \sim \text{Exponential}(\lambda)$ is realized, the planner dictates whether the worker stays with the firm or separates. The planner makes this ex-post decision by comparing the total surplus generated in each state. If the worker stays, the surplus is ri. If the worker separates, the surplus is $v+\rho i$.

It is therefore socially efficient for the worker to stay if and only if the surplus from staying exceeds the surplus from separating. We typically assume $r > \rho$, meaning investment is more productive inside the firm.[9] The efficient separation rule is to continue the match whenever

$$ri \geq v+\rho i \quad \iff \quad v \leq (r-\rho)i. \tag{1}$$

Letting $\Delta := r-\rho$ denote the productivity gap, the planner retains the match if $v \leq \Delta i$.

Anticipating this efficient separation rule, the planner chooses the investment level i ex-ante to maximize the expected total surplus:

$$\mathscr{S}(i) = \int_0^{\Delta i} (ri)\lambda e^{-\lambda v} dv + \int_{\Delta i}^{\infty} (v+\rho i)\lambda e^{-\lambda v} dv - \frac{1}{2}i^2.$$

[9] When $\rho \geq r$, it is straightforward to show that the planner always separates ex-post and sets $i^\star = \rho$.

Using the properties of the exponential distribution, this simplifies to:

$$\mathscr{S}(i) = -\frac{1}{2}i^2 + ri + \frac{e^{-\lambda\Delta i}}{\lambda}.$$

The socially optimal level of investment, $i^\star$, is therefore implicitly defined by the first-order condition $\mathscr{S}'(i^\star) = 0$, which equates the social marginal benefit of investment (SMB) with the marginal cost of investment:

$$\underbrace{r - \Delta e^{-\lambda\,\Delta\, i^\star}}_{=\mathrm{SMB}(i^\star)} \;=\; i^\star. \tag{2}$$

Appendix A.1 shows the existence and uniqueness of the investment level as well as the comparative statics of optimal investments and quit probabilities with respect to the parameters of the model.

2.2.2 Allocative Inefficiency with Fixed Investments and Wages

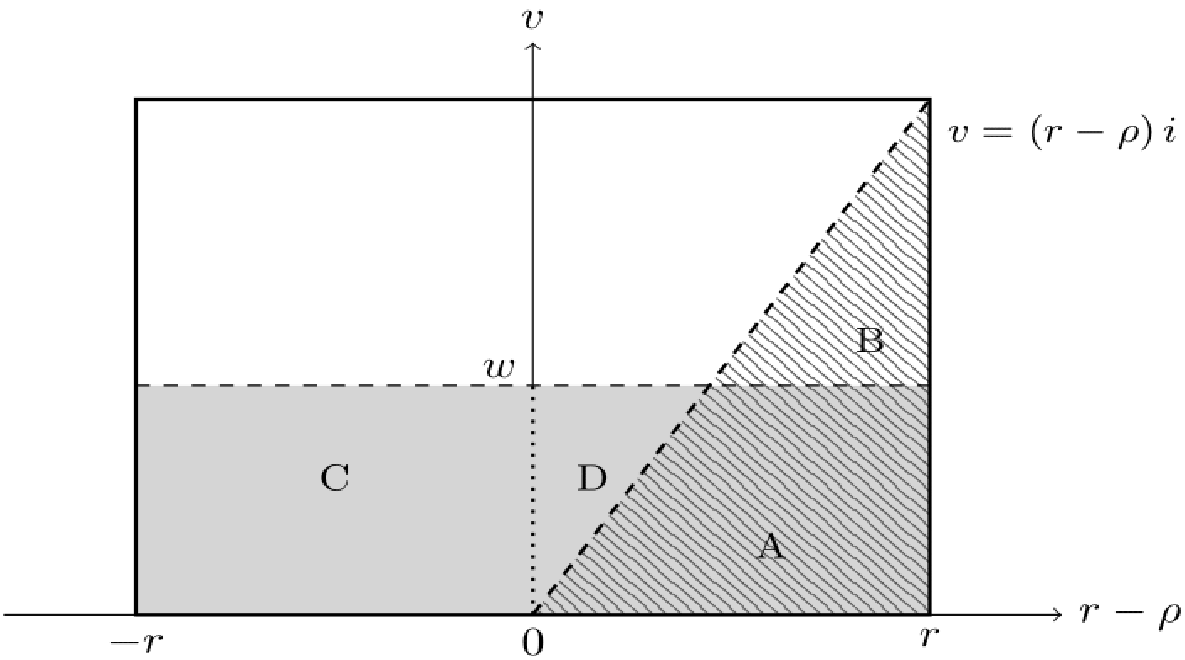
To isolate the allocative inefficiencies arising from contractual rigidity, we analyze a simplified case where investments and wages are fixed parameters. In this setting, the only actions consist of the parties making separation decisions in period 2. We compare the ex-post separation decisions under contracts with and without an NC. The comparison between private and efficient decision rules is illustrated in Figures 2 and 3.

As shown in Equation 1, retention is efficient if and only if $v \leq (r-\rho)i$. Efficient stay is depicted by the hatched regions A and B in Figure 2 and Figure 3. With an NC ($\delta = 1$), the worker's outside option is simply v and will stay as long as $w \geq v$. This decision rule is represented by the shaded regions A, C and D in Figure 2. There are two types of allocative inefficiencies under this arrangement. First, it leads to inefficient stays ("job lock"), depicted by region C and D in Figure 2, where separation is efficient but does not occur. In region C, separation is efficient since $\rho > r$, but since $w > v$, the worker will stay in the job. Similarly, in region D, $v > (r-\rho)i$ but $w > v$ and it leads to inefficient stays. Second, inefficient quits can still occur with an NC, and corresponds to the region below the dashed line and above the shaded area in region B of Figure 2 , where $(r-\rho)i > v > w$.

In the absence of an NC ($\delta = 0$), the worker's outside option is $v + \rho i$, and their private decision rule is to separate if $v + \rho i > w$. This can lead to inefficient quits, depicted by region B in Figure 3, which occur when the worker leaves even though retention is socially optimal ($ri > v + \rho i > w$).[10] However, this arrangement ensures all socially efficient separations are realized. Since the

[10]We note that all else equal, there are fewer inefficient quits with an NC, as $Pr\Big((r-\rho)i > v > w-\rho i\Big) > Pr\Big((r-$

Figure 2: Separation Decisions with a Non-Compete Agreement



firm's participation constraint ensures $w \leq ri$, the condition for an efficient separation ($v + \rho i > ri$) necessarily implies the condition for a private separation ($v + \rho i > w$). Thus, no inefficient stays occur.

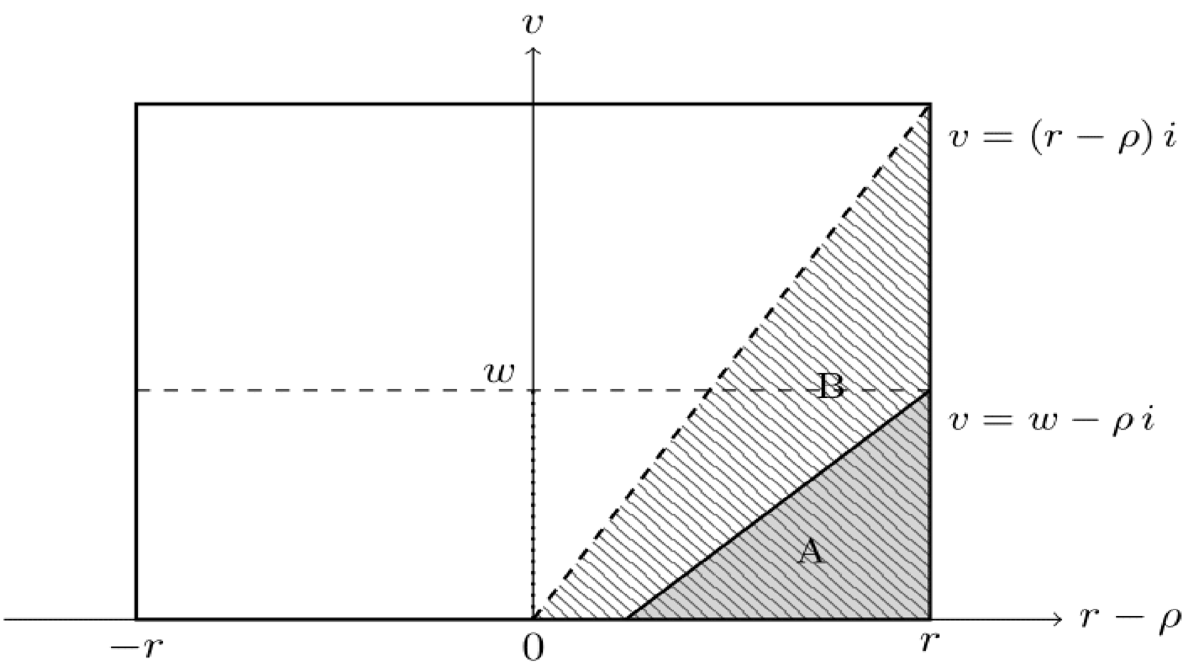
This analysis of the fixed investment and wage case reveals a fundamental trade-off. Contracts without NCs ensure all efficient separations occur but are susceptible to inefficient quits. Conversely, contracts with NCs reduce inefficient quits but introduce the possibility of inefficient stays (job-lock).

2.2.3 Spot-Market Equilibrium: Inefficient Separations and Under-investment

To understand the surplus generated by contractual commitment, we also consider a spot-market benchmark without wage commitment. The game proceeds in two stages. First, the firm chooses an investment level $i_s \geq 0$ at cost $\frac{1}{2}i_s^2$. Second, after the worker's outside option $v \sim \text{Exp}(\lambda)$ is realized, the firm makes a take-it-or-leave-it wage offer w_s. The worker accepts if $w_s \geq v + \rho i_s$. In equilibrium, the firm chooses its investment i_s^* anticipating its own subsequent optimal wage-setting. We then compare this equilibrium to the social planner's benchmark, which is characterized by the efficient separation threshold $v_{\text{eff}}(i) = (r - \rho)i$ and the optimal investment level i^* that satisfies

$\rho)i > v > w\Big)$.

Figure 3: Separation Decisions without a Non-Compete Agreement



$\text{SMB}(i^*) = i^*$.

Proposition 1 (Spot Market Inefficiency)**.** *The spot-market equilibrium is inefficient in two dimensions:*

(i) **Inefficient Separations:** *For any given level of investment $i_s > 0$, the market generates an inefficiently high rate of separations. The spot market separation threshold is strictly lower than the efficient threshold.*

(ii) **Under-investment:** *The equilibrium investment level i_s^* is strictly lower than the socially optimal level i^*.*

The reasoning for this two-fold inefficiency is as follows: First, separations are inefficiently high because the firm's wage offer must be less than the worker's marginal product ($w_s^* < ri_s$). This profitability constraint creates a gap where separations are socially inefficient but rational for the worker individually. This occurs when retention is socially efficient ($ri_s > v + \rho i_s$), yet the worker's private outside option is superior than the wage they are offered ($v + \rho i_s > w_s^*$). In these cases, an inefficient quit occurs. Second, the firm under-invests because it fails to capture the full social returns of its investment. When a separation does occur, the firm's investment still provides a benefit to the worker by increasing his productivity by ρi_s. The firm does not internalize this external gain when choosing its investment level. The firm also anticipates that raising its investment increases the probability that the worker will quit. Since higher investment makes a costly separation more likely, the firm's expected return is diminished, further discouraging it from investing at the socially optimal level. The formal proof for Proposition 1 is provided in the Appendix Subsection A.2.

2.3 Subgame Perfect Equilibrium with a Non-Compete Agreement

2.3.1 Equilibrium Characterization

The equilibrium is solved via backward induction. Before analyzing the firm's choices, we define the worker's expected utility. In the Production Stage, the worker stays if $v \leq w_1$ and quits if $v > w_1$. The worker's ex-ante expected future utility, $E[U_W(w_1)]$, calculated before the outside option v is realized, is therefore:

$$
\begin{aligned}
E[U_W(w_1)] &= \int_0^{w_1} w_1 \lambda e^{-\lambda v} dv + \int_{w_1}^{\infty} v \lambda e^{-\lambda v} dv \\
&= w_1(1 - e^{-\lambda w_1}) + e^{-\lambda w_1}(w_1 + 1/\lambda) \\
&= w_1 + \frac{1}{\lambda} e^{-\lambda w_1}.
\end{aligned}
$$

The worker's participation constraint, checked in Stage 1, is $B_1 + \beta E[U_W(w_1)] \geq \mu^0$.

In Stage 2, for a given wage w_1, the firm chooses investment i_1 to maximize its expected profit, anticipating the worker's separation decision:

$$
\max_{i_1 \geq 0} \quad \underbrace{(r i_1 - w_1)}_{\text{Profit if stay}} \underbrace{\Pr(v \leq w_1)}_{(1 - e^{-\lambda w_1})} - \frac{1}{2} i_1^2
$$

The first-order condition yields the firm's optimal investment response function:

$$
i_1(w_1) = r(1 - e^{-\lambda w_1}). \tag{3}
$$

This expression indicates that in equilibrium, the marginal cost of investment equals the expected private marginal return to investment, which equals the probability the worker stays $(1 - e^{-\lambda w_1})$ multiplied by marginal product r of investment. In Stage 1, the firm chooses (w_1, B_1) to maximize its profit. Since the bonus B_1 can be used to transfer utility ex-ante, this problem is equivalent to choosing w_1 to maximize the private joint surplus of the match, Σ_1, subject to the constraint that the firm will not fire the worker ($w_1 \leq r i_1$). Although the firm has the option to fire the worker in period 2, this option is never exercised in equilibrium.[11] To see why, observe that if wages are above marginal product in the final period, the firm must earn profits in the first period for the relationship to be profitable. However, anticipating that a firing will occur, the firm will make no investments. The worker is well aware of the firm's incentives and thus would be unwilling to earn below marginal product in the first period for investment that never occurs, so the relationship will not materialize in the first place. We denote this feature as the firm's "viability constraint", which rules out wage-tenure profiles where wages can exceed marginal product, as in the implicit insurance contracts explored in Harris and Holmstrom (1982).

The joint surplus is the sum of the firm's profit and the worker's discounted expected utility:

$$\Sigma_1(w_1) = \left[(ri_1(w_1) - w_1)(1 - e^{-\lambda w_1}) - \frac{1}{2} i_1(w_1)^2\right] + \beta E[U_W(w_1)].$$

Substituting in the expression for $E[U_W(w_1)]$, maximizing Σ_1 with respect to w_1, and applying the Envelope Theorem yields the following key relationship.

Proposition 2 (Optimal Contract Structure)**.** *The optimal wage w_1 and the corresponding investment level $i_1(w_1)$ are related by the equation:*

$$w_1 = ri_1(w_1) + \frac{(\beta - 1)(e^{\lambda w_1} - 1)}{\lambda}. \tag{4}$$

For any worker patience $\beta \leq 1$, this contract ensures the equilibrium wage satisfies the firm's viability constraint, $w_1 \leq ri_1(w_1)$, so the firm does not fire the worker.

In Appendix Section A.3, we provide the necessary and sufficient conditions for a non-zero wage. All further analysis imposes $\lambda r^2 > 2$, which provides a sufficient condition. This wage structure creates a back-loaded compensation profile, where workers receive lower compensation early in the job in exchange for higher wages in the future. The steepness of this intertemporal trade-off is governed by the worker's patience β. A more patient worker is more willing to trade present for future earnings, accepting lower initial compensation (B_1) in exchange for a higher future wage (w_1). When $\beta = 1$, the worker earns exactly marginal product in the final period; to satisfy the firm's participation constraint, it must be the case that the worker earns less than marginal product in the initial period, leading to an upward sloping wage-tenure profile.

[11] According to 2017 NLSY97 data, approximately 5% of workers were fired, making this feature of the model relatively realistic.

2.3.2 Comparison with the Social Optimum

The structure of the private contract deviates from the social optimum because the firm's objective function ignores the external productivity parameter ρ. We formally compare the investment levels for the case where the worker is perfectly patient ($\beta = 1$).

Proposition 3 (Private vs. Social Investment)**.** *When $\beta = 1$, private investment with a non-compete, i_1, is compared to the social optimum, i^*, as follows:*

- *A sufficient condition for under-investment ($i_1 < i^*$) is $1 - \lambda r i^* > 0$.*
- *A sufficient condition for over-investment ($i_1 > i^*$) is $1 - \lambda \Delta i^* < 0$, where $\Delta = r - \rho$.*

The potential for both over- and under-investment stems from how the non-compete contract mis-aligns private and social incentives. With a perfectly patient worker ($\beta = 1$), the wage is set to the marginal product, $w_1 = r i_1$. This structure eliminates inefficient quits, but creates two competing distortions. First, the contract creates inefficient stays, which occur when a quit is socially optimal ($v > (r - \rho) i_1$) but does not happen because the worker's outside offer is below the wage ($v \leq r i_1$). In this region, the firm values the marginal return on its investment at r, whereas the planner would have valued it at ρ had the worker moved. Since $r > \rho$, the firm's incentive to invest is stronger than the planner's in this state, creating a force for over-investment. Second, the non-compete contract misvalues efficient quits. When the worker's outside offer is high enough to induce a quit ($v > r i_1$), the firm's return on its investment is zero. The social planner, however, recognizes that the investment still generates value through the worker's enhanced productivity at a new firm, yielding a social return of ρ. Because the firm completely disregards this post-separation value, its investment incentive is weaker than the planner's in this state, creating a force for under-investment. The ultimate comparison to the efficient level is therefore ambiguous, as it depends on which of these forces dominates. If the risk of quitting to high-value outside offers is significant, the firm's failure to internalize the post-quit value (ρ) can lead to under-powered investment incentives. If, however, quit risk is low and investments are highly specific, the firm's desire to reap its full internal return (r) can lead to over-powered investment incentives. The formal proof is provided in Appendix A.4.

2.3.3 Comparative Statics of the Non-Compete Equilibrium

The parameters of the model influence the equilibrium wage, which in turn affects the worker's quit decision, the firm's investment level, and the total surplus generated by the match. The following proposition summarizes these relationships.

Proposition 4 (Comparative Statics of Equilibrium Outcomes)**.** *In the equilibrium with an NC, the effects of the model parameters on the equilibrium wage (w_1), bonus (B_1), quit probability ($q_1 := Pr(v > w_1) = e^{-\lambda w_1}$), investment ($i_1$), and maximized joint surplus (Σ_1^*) are as follows:*

(i) An increase in r raises the wage, lowers the bonus, lowers the quit probability, increases investment, and increases the joint surplus.

(ii) A change in the skill-generality parameter, ρ, has no effect on any equilibrium outcome.

(iii) An increase in worker patience, β, raises the wage, lowers the bonus, lowers the quit probability, increases investment, and increases the joint surplus.

(iv) The effect of the quit rate parameter, λ, depends on worker patience.

- *If $\beta = 1$, an increase in λ raises the wage, lowers the quit probability, and increases investment, but decreases the joint surplus.*
- *If $\beta < 1$, the effects of an increase in λ on all equilibrium variables are ambiguous.*

These results reveal how the firm strategically designs the non-compete contract in response to changes in the economic environment. An increase in the worker's internal productivity (r) or patience (β) makes the employment relationship more valuable. A higher r means investment generates more output, while a higher β means the worker is more willing to accept future compensation. In both cases, the firm responds by offering a more back-loaded contract with a higher future wage (w_1) and a lower upfront bonus (B_1). The higher wage is a strategic choice: it reduces costly worker turnover, which in turn secures the returns on a higher level of firm investment (i_1). This virtuous cycle of lower quits and higher investment leads to a larger total surplus. Notably, the skill-generality parameter (ρ) is irrelevant in the non-compete equilibrium. The non-compete clause effectively insulates the firm from the worker's value to industry competitors. Since the worker's outside option is independent of ρ, it does not factor into the firm's or worker's decisions. The effect of the outside offer distribution (λ) is more complex. A higher λ implies that outside offers are, on average, worse ($E[v] = 1/\lambda$). For a perfectly patient worker ($\beta = 1$), the firm reacts to worse outside offers by becoming more aggressive in its retention strategy. It raises the future wage (w_1) to lower the quit probability, which then justifies a higher investment (i_1). Nevertheless, the overall joint surplus falls because the external environment (the value of the quit option) has become less favorable. When the worker is impatient ($\beta < 1$), the firm's response is ambiguous, as it must balance the benefit of retaining the worker against the higher cost of paying a future wage that the worker undervalues. The formal proof is provided in Appendix A.5.

2.4 Subgame Perfect Equilibrium Without a Non-Compete Agreement

2.4.1 Equilibrium Characterization

The equilibrium is characterized by the firm's optimal investment and wage choices. The firm chooses the wage w_0 to maximize the private joint surplus of the match, anticipating its own investment response in the subsequent stage. The joint surplus, Σ_0, is the sum of the firm's expected profit and the worker's discounted expected future utility:

$$\Sigma_0(w_0, i_0) = (ri_0 - w_0)(1 - e^{-\lambda T_0}) - \frac{1}{2}i_0^2 + \beta\left(w_0 + \frac{1}{\lambda}e^{-\lambda T_0}\right)$$

where $T_0 = w_0 - \rho i_0$ is the retention threshold for labor demand conditions v.

First-Order Condition for Investment. In Stage 2, the firm chooses i_0 to maximize its own expected profit, $E[\Pi_0] = (ri_0 - w_0)(1 - e^{-\lambda T_0}) - \frac{1}{2}i_0^2$, taking the wage w_0 as given. The first-order condition implicitly defines the firm's investment response function, $i_0(w_0)$:

$$H(i_0, w_0) \equiv \underbrace{r(1 - e^{-\lambda T_0})}_{\text{Marginal Product Effect}} - \underbrace{(ri_0 - w_0)\lambda\rho e^{-\lambda T_0}}_{\text{Hold-up Cost}} - \underbrace{i_0}_{\text{MC}} = 0 \tag{5}$$

This condition characterizes the firm's optimal investment choice in Stage 2, taking the wage w_0 as fixed. The first term, $r(1 - e^{-\lambda T_0})$, is the expected marginal benefit of investment: the gain in the worker's productivity if the match persists multiplied by the probability the match persists. The second term, $(ri_0 - w_0)\lambda\rho e^{-\lambda T_0}$, captures the hold-up problem: by investing more, the firm raises the worker's outside option and thus the likelihood of a quit, making it more probable that the firm will lose its profit margin on the worker, $(ri_0 - w_0)$.

First-Order Condition for Wages. The firm chooses w_0 to maximize the joint surplus $\Sigma_0(w_0, i_0(w_0))$, subject to the viability constraint $w_0 \leq ri_0(w_0)$. The unconstrained optimum, which we denote w^*_{unc}, is the wage that solves the first-order condition $\frac{d\Sigma_0}{dw_0} = 0$. This total derivative is:

$$\frac{d\Sigma_0}{dw_0} = \frac{\partial \Sigma_0}{\partial w_0} + \frac{\partial \Sigma_0}{\partial i_0}\frac{di_0}{dw_0} = 0 \tag{6}$$

The partial derivatives are $\partial\Sigma_0/\partial w_0 = (\beta - 1)(1 - e^{-\lambda T_0}) + \lambda(ri_0 - w_0)e^{-\lambda T_0}$ and $\partial\Sigma_0/\partial i_0 = \beta\rho e^{-\lambda T_0}$. Substituting these into the above equation yields the wage FOC:

$$\lambda e^{-\lambda T_0}(ri_0 - w_0) + (\beta - 1)(1 - e^{-\lambda T_0}) + \beta\rho e^{-\lambda T_0}\frac{di_0}{dw_0} = 0 \tag{7}$$

This condition characterizes how the firm optimally sets the wage to maximize joint surplus, accounting for both direct and indirect effects.

- The first term, $\lambda e^{-\lambda T_0}(ri_0 - w_0)$, reflects the firm's gain from increasing retention: raising the wage increases the probability the worker stays, which is valuable when the worker's marginal product exceeds his wage.
- The second term, $(\beta - 1)(1 - e^{-\lambda T_0})$, captures the cost of transferring surplus to an impatient worker. If the worker is impatient ($\beta < 1$), then increasing the wage reduces joint surplus because the worker undervalues the extra compensation.
- The third term, $\beta \rho e^{-\lambda T_0} \frac{di_0}{dw_0}$, is the indirect benefit of higher wages through investment incentives: a higher wage reduces hold-up risk, encouraging more investment, which in turn raises the worker's future utility by improving his outside option.

Note that this unconstrained solution is only chosen if it is feasible. If w^*_{unc} violates the viability constraint (i.e., if $w^*_{unc} > ri_0(w^*_{unc})$), then the equilibrium wage will be a corner solution. In this case, the firm is constrained and will choose the highest possible wage that still satisfies viability. This is the wage w^*_0 that lies on the boundary of the feasible set, solving the fixed-point equation $w^*_0 = ri_0(w^*_0)$. We show the existence of this fixed point and the conditions under which it is positive in Appendix A.6.[12] As in the case with a non-compete, this optimal contract features a back-loaded compensation profile. The worker's patience, β, determines the steepness of this intertemporal trade-off. A more patient worker is more willing to trade lower initial compensation (B_0) for a higher future wage (w_0) that encourages greater firm investment. This dynamic is most apparent in the limit where the worker is perfectly patient ($\beta = 1$). In this case, the unconstrained solution would feature a wage above marginal product. Under such an agreement, the firm would be motivated to fire the worker ex-post, so the viability constraint binds and the equilibrium is a corner solution where the worker receives exactly product in the final period.[13] To ensure the firm participates ex-ante, wages are below marginal product in the initial period, again leading to an upward sloping wage-tenure profile.

2.4.2 The Hold-Up Problem: Under-investment

Proposition 5 (Under-investment without a Non-Compete). *In the equilibrium without an NC, the firm's investment level, i^*_0, is strictly less than the socially optimal level, i^*.*

[12] Throughout our analysis, we assume parameter values satisfy both $\lambda r(r - \rho) > 1$ and $\lambda r^2 > 2$. As shown in the Appendix, the first condition ensures a positive wage and investment in the equilibrium without a non-compete, while the second is a sufficient condition ensuring a positive wage in the equilibrium with a non-compete. These assumptions ensure that we are always comparing two non-trivial contractual outcomes.

[13] We prove formally that $\frac{di_0}{dw_0} > 0$ in Appendix A.7, which guarantees the unconstrained wage (without imposing the viability constraint) is above marginal product.

The proof establishes this result by showing that under-investment occurs even in the most efficient possible contract without a non-compete, and this inefficiency is only compounded in more general cases. The best-case scenario occurs when the wage is set at the highest possible level that allows the firm to break even on a retained worker ($w_0 = ri_0$), a situation that arises with a perfectly patient worker. This contract is efficient in one dimension: it eliminates inefficient quits by aligning the private separation decision with the social one. However, the firm still under-invests because it fails to internalize the full benefits of its investment upon an efficient separation. When the worker leaves, the firm receives nothing, but its investment still generates social value by increasing the worker's productivity at a new firm by ρ. Since the firm ignores this positive externality, its private incentive to invest is strictly lower than the social planner's.

This under-investment problem is compounded when the worker is not perfectly patient. In this case, the optimal wage is below the worker's marginal product ($w_0^* < ri_0^*$), which re-introduces the problem of inefficiently high quits. This lower wage not only creates excessive turnover but also directly reduces the firm's investment level. Because investment is already suboptimal even in the best-case scenario, it must therefore always be strictly below the social optimum. The formal proof, which establishes this result by analyzing an upper bound for investment, is provided in Appendix A.8.

2.4.3 Dominance of the No-NC Contract over the Spot Market

To understand the value of contracting, we compare the joint surplus generated by the optimal wage-commitment contract without an NC for a perfectly patient worker ($\beta = 1$) to the spot-market equilibrium. We show that the No-NC contract strictly dominates the spot market by supporting both a higher level of investment and more efficient separation decisions.

Proposition 6 (*Surplus Dominance of the No-NC Contract*)**.** *For the case of a perfectly patient worker ($\beta = 1$), the joint surplus from a No-NC contract is strictly greater than the joint surplus from the spot market equilibrium ($\Sigma_0^* > \Sigma_s^*$).*

This result highlights the value of contractual commitment. The No-NC contract dominates the spot market by solving key inefficiencies on both the separation and investment margins. In the spot market, the lack of wage commitment forces the firm to offer a wage strictly below the worker's marginal product to ensure profitability, which leads to inefficiently high turnover, as workers will sometimes quit even when it is socially optimal for them to stay.

The No-NC contract with a patient worker ($\beta = 1$) overcomes this problem. The ability to commit allows the firm to set a future wage equal to the worker's marginal product ($w_0^* = ri_0^*$). This arrangement is feasible because the patient worker is willing to compensation below marginal product in the initial period. This superior contract structure leads to two clear benefits. First, it ensures efficient turnover. By setting the wage to the marginal product, the worker's private incentive to separate aligns perfectly with the socially efficient threshold (conditional on investment), eliminating the inefficient quits that plague the spot market. Second, this improved retention directly encourages more investment. Because the firm anticipates a lower probability of the worker quitting, its expected return on investment is higher, leading to an equilibrium investment level (i_0^*) strictly greater than in the spot market (i_s^*). Since the No-NC contract generates both more efficient separations and a higher level of investment, it strictly dominates the spot-market equilibrium in total surplus. The formal proof, which demonstrates dominance on both the investment and separation margins, is provided in Appendix A.9.

2.5 Comparing NC to No-NC Contracts: Investment, Wage-Tenure Profiles, Contract Choice

2.5.1 NCs Raise Investment

Proposition 7 (NCs and Investment Incentives)**.** *Let $i_1(w)$ and $i_0(w)$ be the firm's optimal investment response functions to a given wage w with and without an NC, respectively. Let i_1^* and i_0^* be the corresponding equilibrium investment levels.*

(a) For any viable wage w and skill transferability $\rho > 0$, the firm's investment response is strictly higher with an NC: $i_1(w) > i_0(w)$.

(b) When the worker does not discount the future ($\beta = 1$), the equilibrium investment is strictly higher with an NC: $i_1^* > i_0^*$.

Corollary 1. *For the benchmark case of a perfectly patient worker ($\beta = 1$), the non-compete agreement alters the structure of the equilibrium contract in the following ways:*

(a) The equilibrium wage is strictly higher ($w_1 > w_0$).

(b) The equilibrium quit probability is strictly lower ($q_1 < q_0$).

(c) The comparison of the upfront bonuses (B_1 vs. B_0) is ambiguous.

Corollary 2 (Compensating Wage Differential)**.** *If the equilibrium wage with a non-compete is strictly lower than the equilibrium wage without a non-compete ($w_1 < w_0$), then the upfront bonus must be strictly higher ($B_1 > B_0$), assuming the worker has a positive discount factor ($\beta > 0$).*

The main proposition establishes that NCs foster higher investment by resolving two distinct disincentives that exist in contracts without this protection. First, for any given level of investment and wages, the baseline probability of a quit is higher without a non-compete because the worker's outside option is enhanced by their value to competitors. This elevated turnover risk naturally lowers the expected return on any investment the firm makes. Second, the act of investing further undermines the firm's position: raising investment by one unit also raises the probability of a quit. This hold-up effect, where investment actively increases the risk of separation, creates a disincentive to invest. A non-compete agreement mitigates both problems, providing a stronger private incentive for the firm to invest.

The corollaries explore the consequences of this higher investment. For a perfectly patient worker ($\beta = 1$), wages are set to the marginal product ($w_\delta = ri_\delta$). Since an NC leads to higher investment ($i_1^\star > i_0^\star$), it directly follows that it also supports a higher equilibrium wage ($w_1 > w_0$). This higher wage, in turn, unambiguously lowers the quit probability. The effect on the upfront bonus, however, is ambiguous. While the NC contract offers a higher future wage, it also restricts the worker's mobility, reducing the quit option value. The net effect on the worker's ex-ante expected utility is therefore unclear. The second corollary further clarifies this trade-off. It establishes that if a non-compete contract were to offer a lower wage, it must compensate the worker with a higher upfront bonus, as the worker would face two disadvantages: a lower direct wage and a less valuable option to quit. To offset this double loss, the firm must provide a larger initial payment to satisfy the worker's participation constraint. The formal proofs for the proposition and its corollaries are provided in Appendix A.10.

2.5.2 Incentives to Use NCs

This section explores the conditions under which firms and workers prefer contracts with or without NCs. The choice depends critically on how transferable skills are across firms (ρ) and how much workers value future income (β).

Proposition 8.

- *When skills are entirely firm-specific, the hold-up problem vanishes. The No-NC and NC contracts are identical.*
- *Industry-Specific Skills ($\rho > 0$) with a Patient Worker ($\beta = 1$): The choice of contract is determined by a unique tipping point, $\hat{\rho} \in (0, r)$.*
  - *For all skill generality levels below the tipping point ($\rho \in (0, \hat{\rho}]$), the No-NC contract is strictly preferred.*
  - *For levels above the tipping point ($\rho > \hat{\rho}$), a marginal increase in skill generality decreases the surplus of the No-NC contract, increasing the relative incentive to use an NC contract.*

- *This tipping point $\hat{\rho}$ is strictly increasing in both the internal return on investment (r) and the quit rate parameter (λ), expanding the range where the No-NC contract is favored.*

- *Industry-Specific Skills ($\rho > 0$) with an Impatient Worker ($\beta < 1$): The effect of skill generality on contract choice is ambiguous.*

- *When the worker is completely impatient ($\beta = 0$), the firm's expected profit is strictly higher under a Non-Compete (NC) contract than under a No-Non-Compete contract. The firm will therefore unambiguously choose the NC contract.*

Corollary 3. *If investment makes a worker more productive for a competitor than for the incumbent firm ($\rho > r$), a non-compete is always strictly preferred to a No-NC contract, which would yield zero surplus.*

Corollary 4. *When the worker is perfectly patient ($\beta = 1$), if the non-compete (NC) contract is preferred over the no-non-compete (No-NC) contract, it is also preferred over the spot market by transitivity.*

This analysis reveals that the choice between the NC and no-NC contracts hinges on a crucial trade-off between fostering investment and allowing for efficient separations. When skills are purely firm-specific ($\rho = 0$), the hold-up problem is absent, rendering the two contracts identical. However, once skills become valuable to competitors ($\rho > 0$), the choice becomes critical.

For a patient worker ($\beta = 1$), skill transferability is a double-edged sword. While a higher ρ increases the value of an efficient quit (a benefit only realized with a No-NC contract), it also exacerbates the hold-up problem, depressing the firm's incentive to invest. The model shows that for low levels of skill transferability ($\rho < \hat{\rho}$), the benefit of enabling efficient quits outweighs the cost of the mild hold-up problem, making the No-NC contract superior. As skills become highly transferable ($\rho > \hat{\rho}$), incentives to use an NC rise. The tipping point $\hat{\rho}$ increases with the internal productivity r and the quit rate parameter λ. A higher r strengthens the firm's internal returns on investment, allowing it to tolerate greater skill transferability before the hold-up costs become too severe, thus expanding the range of ρ where No-NC is preferred. Similarly, a higher λ implies lower expected outside offers (since $E[v] = 1/\lambda$), which reduces baseline quit risks and mitigates the severity of the hold-up problem, again favoring No-NC over a broader parameter space. In the extreme case where investment makes a worker more productive for a competitor ($\rho > r$), a non-compete is essential for any investment to occur at all, and so will be used.

Worker patience is the other key determinant. When a worker is completely impatient ($\beta = 0$) and values only the upfront bonus, the choice of contract falls entirely to the firm to maximize its own profit. The firm unambiguously chooses the non-compete because it reduces costly turnover and fully protects its investment returns. This result provides a potential explanation for the prevalence of NCs among low-wage or financially constrained workers, who may exhibit high effective discount rates. A large body of research in economics suggests that financial pressures can lead individuals to prioritize immediate cash over future income streams (Zeldes 1989; Lawrance 1991). More recent work posits that the cognitive load imposed by financial scarcity can itself foster a focus on short-term needs (Shah, Mullainathan, and Shafir 2012). Our model shows that under such conditions of worker impatience, firms have a clear profit-based incentive to use NCs. Finally, the results establish a clear hierarchy of contracts: when the NC contract is preferred to the No-NC contract for a patient worker, it is, by transitivity, also superior to a simple spot-market relationship. This result explains why the parties would write a contract with an NC as opposed to engaging in the spot-market. The formal proofs are provided in Appendix A.11.

2.6 Allowing for Renegotiation of the Non-Compete Agreement

2.6.1 Firm Holds All Bargaining Power

We extend the model to allow for renegotiation after labor demand conditions v are realized. Unlike the baseline model where v is private information, v is observable to both parties, reflecting settings like executive contracts where information is more symmetric. Now the firm can restructure the non-compete agreement and contractual wages after investment is sunk but before trade or separation occurs. In particular, the firm can match outside offers or allow the worker to leave for an industry competitor in exchange for a buyout payment. If the worker rejects the firm's new offer, the original contract terms still hold. Thus, renegotiation is by mutual consent, as in MacLeod and Malcomson (1993). The timing is as follows:

1. The firm offers an initial contract with an NC $(w_1, B_1, \delta = 1)$ and the worker accepts or rejects.

2. The firm chooses an investment level i_1 at cost $\frac{1}{2}i_1^2$.

3. Labor demand conditions v with continuously differentiable CDF $F()$ are realized and *observed by all parties.*

4. The firm offers a renegotiated contract $\{\bar{w}, \bar{\tau}, \bar{\delta}\}$, where:

   - $\bar{w}$ is the new wage if the parties trade,
   - $\bar{\tau}$ is the termination payment from the worker to firm upon separation,
   - $\bar{\delta} \in \{0, 1\}$ is the revised non-compete status of the contract. If $\bar{\delta} = 0$, the firm waives the non-compete agreement and the worker's outside option is $v + \rho i_1$; otherwise, it remains v.

5. The worker accepts or rejects the revised offer. If rejected, the original contract governs. The parties then decide whether to trade or separate.

LEMMA 1 (Equilibrium Renegotiation)**.** *In the renegotiation subgame, the firm offers a contract that the worker accepts. This contract implements the efficient action (trade or separation) and ensures the worker obtains flow utility* $\max\{w_1, v\}$.

Proof. After the realization of v, the firm offers a take-it-or-leave-it contract $\{\bar{w}, \bar{\tau}, \bar{\delta}\}$. The worker will accept if the contract yields at least $\max\{w_1, v\}$, which is the best available utility under the original contract where the non-compete is enforced.

Case 1: Trade is efficient. This occurs when

$$ri_1 \geq v + \rho i_1.$$

The firm prefers to trade. It sets $\bar{\delta} = 1$ to enforce the non-compete, so the worker's fallback option remains $\max\{w_1, v\}$. The firm offers:

$$\bar{w} = \max\{w_1, v\}, \quad \bar{\delta} = 1.$$

Separation does not occur, so the termination payment $\bar{\tau}$ is irrelevant. The worker accepts and earns utility $\bar{w}$, and the firm earns profit $ri_1 - \bar{w}$.

Case 2: Separation is efficient. This occurs when

$$v + \rho i_1 > ri_1.$$

The firm sets $\bar{\delta} = 0$ to waive the non-compete and allow the worker to quit and access $v + \rho i_1$. To ensure the worker is indifferent between accepting and rejecting, the firm sets:

$$v + \rho i_1 - \bar{\tau} = \max\{w_1, v\} \quad \Rightarrow \quad \bar{\tau} = v + \rho i_1 - \max\{w_1, v\}.$$

The firm earns $\bar{\tau}$, and the worker earns $\max\{w_1, v\}$. The worker accepts.

Conclusion. In both cases, the firm implements the efficient action and extracts the surplus above $\max\{w_1, v\}$. ■

Proposition 9 (Renegotiation Ensures Efficient Investments and Allocations)**.** *In the model with renegotiation and industry-specific skills:*

1. *Efficient Turnover: For any investment level* i_1*, there is trade if and only if* $v \leq (r - \rho)i_1$.

2. *Efficient Investment: The firm chooses the efficient investment level i^* that solves*

$$(r-\rho)F\big((r-\rho)i^*\big)+\rho = i^*,$$

which maximizes expected total surplus.

Proof. (1) Efficient Turnover. From Lemma 1, the firm compares its profit under trade versus separation:

$$\text{Trade: } ri_1 - \max\{w_1, v\}, \quad \text{Separation: } v+\rho i_1 - \max\{w_1, v\}.$$

The firm prefers trade if and only if:

$$ri_1 \geq v+\rho i_1 \quad \Leftrightarrow \quad v \leq (r-\rho)i_1.$$

This implements the socially efficient cutoff rule.

(2) Efficient Investment. The firm chooses i_1 to maximize expected profit:

$$\begin{aligned}\Pi(i_1) = &\int_{-\infty}^{(r-\rho)i_1} \big(ri_1 - \max\{w_1, v\}\big)\, dF(v) \\ &+ \int_{(r-\rho)i_1}^{\infty} \big(v+\rho i_1 - \max\{w_1, v\}\big)\, dF(v) - \frac{1}{2}i_1^2.\end{aligned}$$

Let $\Sigma(i_1)$ denote expected total surplus. Then:

$$\Pi(i_1) = \Sigma(i_1) - \mathbb{E}[\max\{w_1, v\}].$$

Since $\max\{w_1, v\}$ does not depend on i_1, the firm maximizes $\Sigma(i_1)$. Differentiating:

$$\frac{d\Sigma}{di_1} = (r-\rho)F((r-\rho)i_1)+\rho - i_1.$$

Setting $\frac{d\Sigma}{di_1} = 0$ yields the efficient investment condition:

$$(r-\rho)F((r-\rho)i^*)+\rho = i^*. \qquad \blacksquare$$

When renegotiation of the original contract is feasible and the firm can tailor the buyout payment to demand conditions, we show that NCs achieve the first-best. We view this model as more applicable to contracting between firms and chief executive officers, where firms share highly sensitive information to the CEO and both parties may have access to specialized lawyers. Indeed, this model aligns with the empirical findings by Kini, Williams, and Yin (2021), who show that more than 60% of new CEOs have NCs after 2010 and that the CEO is more likely to have a non-compete if the CEO's skills are easily transferable to other firms in the industry. This model yields a more favorable view of NCs than Shi (2023), where asymmetric information on the entrant's valuation prevents the buyout payment from adjusting to demand conditions. Because the design of the buyout payment is central to the efficiency of the contract, in the next two sections, we consider legal remedies that constrain the firm's choice of buyout payments.

2.6.2 Expectation Damages

We now analyze the game under a different, common legal remedy: expectation damages. In this scenario, the payment from the worker to the firm upon separation is designed to make the firm whole, as if the contract had been fulfilled (Shavell 1984). We model expectation damages by contractually fixing the termination fee at the level of the firm's profit from trade at the original wage, $\bar{\tau} = ri_1 - w_1$. As before, separation requires mutual agreement. We show that the insurance granted to the firm by expectation damages results in over-investment and under-separation.

Proposition 10 (Inefficient Under-Separation and Over-Investment under Expectation Damages)**.** *When the termination fee is fixed by expectation damages, the equilibrium outcome is inefficient relative to the social planner's benchmark.*

(a) ***Inefficient Stays (Job Lock):*** *Separation occurs less frequently than is socially optimal.*

(b) ***Over-investment:*** *The firm chooses the maximum possible level of investment, $i_1 = r$, which is strictly higher than the socially optimal level i^*.*

This remedy creates two distinct inefficiencies because it provides perfect insurance to the firm, which distorts both its investment decisions and the joint separation decision. The problem of over-investment arises because the firm has perfect insurance. Because the damage payment $\bar{\tau} = ri_1 - w_1$ guarantees the firm its expected profit regardless of whether the worker stays or quits, the firm is fully insulated from the risk of employee turnover.[14] This creates a moral hazard problem. The firm, when choosing its investment level, no longer needs to discount its returns by the probability of a separation. It invests as if performance is certain, because from its perspective, the return is certain. Since the firm is guaranteed a marginal return of r on its investment, it invests until the marginal cost equals this return, leading to the socially excessive level $i_1 = r$.

This remedy also generates inefficient under-separation because the conditions for mutual consent to separate are stricter than the condition for social efficiency. For a separation to occur, the worker must find it privately optimal to pay the expectation damages, $\bar{\tau} = ri_1 - w_1$. The worker's

[14] Technically, the worker has the option to quit and join the non-industry competitor without paying the fee. However, we show formally in the proof that quits to the non-industry competitor do not occur in equilibrium in this model.

utility from moving to the industry competitor is $v+\rho i_1-\bar{\tau}$, which must exceed their reservation utility of v (given that the firm only consents to waive the NC when $v>w_1$). This requirement simplifies to the condition $w_1 \geq (r-\rho)i_1$. Consequently, a socially efficient separation, which requires only that $v>(r-\rho)i_1$, is blocked whenever the worker's private condition ($w_1 \geq (r-\rho)i_1$) or the firm's private condition ($v>w_1$) is not met. This misalignment leads to inefficiently low turnover to the industry competitor. The formal proof is provided in Appendix A.12.

2.6.3 Training Repayment Programs

We now analyze a modification to the renegotiation game to incorporate a Training Repayment Agreement Program (TRAP), as studied in, for example, Feess and Muehlheusser (2003). In this framework, if the parties mutually agree to waive the non-compete agreement, the worker must pay the firm a contractually fixed termination fee equal to the firm's investment cost, $\bar{\tau}=\frac{1}{2}i_1^2$. This provision represents a specific application of liquidated damages, a contractual mechanism in which the parties pre-commit to a fixed monetary transfer that is payable upon a specified event, such as breach or early termination (e.g. Spier and Whinston 1995). In this case, the worker pays a pre-determined amount to be released from the non-compete agreement, thereby compensating the firm for its upfront investment.

Proposition 11 (Inefficient Matching and Investment under TRAPs)**.** *Relative to the social planner's benchmark, Training Repayment Agreement Programs (TRAPs) create inefficiently low separation and an inefficient level of investment.*

1. ***Under-separation:*** *TRAPs lead to under-separation. In the regime where separation is possible ($i_1 \leq 2\rho$), the threshold for separation is higher than the socially efficient threshold. In the regime where investment is high ($i_1 > 2\rho$), socially efficient separations are completely foreclosed as the worker will never agree to pay the fee.*

2. ***Inefficient Investment:*** *TRAPs lead to an inefficient level of investment. The firm's chosen investment will either be unambiguously excessive (if it chooses a high-investment strategy to prevent separation) or will be pinned down by the need to compensate the worker sufficiently to accept the contract, rather than by maximizing joint surplus.*

TRAPs create inefficiencies because the fixed repayment fee forces the firm into a strategic choice between two distinct investment regimes, neither of which is socially optimal. First, the firm can choose a high-investment strategy. By investing heavily, the firm makes the repayment fee ($\frac{1}{2}i_1^2$) prohibitively expensive for the worker. The worker is effectively locked into the firm or the non-industry outside option; separation to an industry competitor never occurs. Anticipating this lock-in, the firm is incentivized to over-invest relative to the social optimum. Alternatively, the firm can pursue a low-investment strategy, keeping the repayment fee low enough that the worker may be willing to pay it in some cases. However, even in this regime, the outcome is inefficient. The conditions required for both the firm and the worker to mutually agree to the separation are stricter than the condition for social efficiency, which results in less turnover than is socially optimal. The formal proof is provided in Appendix A.13.

3 Empirical Set-up

3.1 Data and Descriptive Relationships

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 worker outcomes, including wages, job mobility, and employer-provided investment. This data set is a nationally representative panel that tracks the outcomes of individuals who were ages 12-16 in 1997. The survey runs annually from 1997-2010, and then biannually from 2011-2021. The survey includes information on each individual's employment history, including hourly wages for each job held, as well as detailed information on demographics and job information.

Importantly, the NLSY97 starts measuring whether NCs 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 currently have an NC. In the following survey years, all individuals who obtain *new* jobs are asked about their non-compete status. We assume throughout that non-compete status is fixed for the duration of the employment relationship.[15] We focus on the 2013-2021 time period and individuals who sign NCs starting in 2015, allowing us to estimate the impact of NCs for up to 6 years. We restrict the analysis to employed workers and remove observations with real hourly wages below \$3 or above \$200, following Deming (2017).[16] When individuals hold multiple jobs in a survey year, we restrict attention to their primary job which we define as the current or most recent employer as of the interview date. If multiple jobs are current, the main job is the one with the longest tenure.

We are interested in the relationships between NCs and various labor market outcomes. We observe the employment history of each worker, including job identifiers and hourly wages at each job, allowing us to assess the impact of signing an NC on wages, wage growth, and job mobility. We consider log wages and job tenure as our main outcome variables throughout the analysis. As

[15] Starr, Prescott, and Bishara (2021) conducts a large survey that asks about the timing of NCs and find that in the vast majority of cases an NC is signed prior to or immediately after starting the job, with only 2.2% associated with promotions or raises.

[16] We construct real hourly wages by deflating nominal hourly pay by annual CPI indices from BLS, setting 2017 as our base year.

Table 1: Respondent Characteristics by Non-Compete Status in 2017

	NC	no NC	Difference	P Value	N: NC	N: No NC
Job Mobility						
Tenure (Yrs)	5.24	5.11	0.12	0.50	699	4185
1(Main Job Separation btwn 2017 and 2019)	0.33	0.37	-0.04	0.04	705	4263
1(Main Job Mobility btwn 2017 and 2019)	0.28	0.31	-0.04	0.05	705	4263
1(Within-Industry Job Mobility btwn 2017 and 2019)	0.10	0.12	-0.02	0.08	686	4176
Wages and Wage Growth						
Log(Starting Wage)	2.94	2.76	0.19	0.00	705	4263
Log(Wage in 2017)	3.21	3.00	0.21	0.00	705	4263
$Log(Wage_{2017}) - Log(Wage_{2015})$	0.13	0.12	0.02	0.22	628	3778
$Log(Wage_{2019}) - Log(Wage_{2017})$	0.11	0.10	0.01	0.56	632	3753
Demographics						
Age	35.03	34.96	0.07	0.25	705	4263
1(Male)	0.58	0.50	0.08	0.00	705	4263
1(High School Degree or Higher)	0.89	0.86	0.03	0.01	699	4224
1(Bachelors Degree or Higher)	0.52	0.42	0.10	0.00	699	4224
ASVAB Percentile	57.50	52.06	5.44	0.00	582	3473
1(Black)	0.14	0.16	-0.02	0.13	705	4263
1(Hispanic)	0.11	0.13	-0.01	0.33	705	4263
Wage Bargaining and Negotiation						
1(Possible to Keep Previous Job)	0.46	0.45	0.01	0.74	304	1848
1(Negotiate Job Offer)	0.40	0.33	0.08	0.02	249	1454
Training						
1(Received Some Training)	0.09	0.11	-0.02	0.12	705	4263
1(Received Training Run by Employer)	0.01	0.03	-0.01	0.03	705	4263
1(Received On-Site Training by Non-Employer)	0.01	0.01	0.00	0.64	705	4263
1(Employer Paid for Training)	0.06	0.08	-0.02	0.08	705	4263
1(Employer Paid for Mandatory Training)	0.03	0.04	-0.01	0.26	705	4263
1(Employer Paid for Voluntary Training)	0.03	0.04	-0.01	0.16	705	4263
Job Tasks						
1(Use Math Skills Frequently)	0.37	0.27	0.10	0.00	661	3808
1(Supervise Frequently)	0.37	0.31	0.06	0.00	662	3802
1(Problem Solve Frequently)	0.85	0.74	0.11	0.00	661	3807
Other Firm Characteristics						
1(Dislike Job)	0.05	0.06	-0.01	0.57	645	3792
1(Unionized Worker)	0.11	0.16	-0.05	0.00	636	3743
Firm Size	986.28	1134.72	-148.43	0.65	595	3377

Note: The sample includes respondents with valid NC status for the main employer in 2017. All wage variables are measured in terms of real dollars earned per hour. Respondents earning real wages below 3 dollars or above 200 dollars are dropped. The training variables capture whether the respondent received training under any employer in 2017. Means weighted by nationally representative sample weights and p-values from a two-sided t-test are reported. Sample sizes vary due to missing values of the outcome variable. For details on variable definitions, refer to Table B1.

robustness we explore other measures of job mobility, such as an indicator variable for whether an individual changed main employers between survey years, and come to similar conclusions. The NLSY97 also asks a variety of questions about formal training programs. As a default, we report statistics pertaining to whether an individual was involved in a formal training program, but also consider whether this training was paid for and/or provided by the employer.

We find that 14 percent of workers in the 2017 cross-section report having an NC in their current job (Table B2). Importantly, over 90 percent of these affirmative respondents report being "Very Confident" in their answer, which supports the modeling assumption that workers are aware of their contract terms and the implications of contract choice. Non-compete usage also varies substantially across the 17 two-digit industries in our sample. Among industries with more than 100 respondents, NCs are most common in Professional and Related Services (26 percent) and least common in Public Administration (8 percent).

In Table 1 we present summary statistics for the 2017 cross-section, comparing workers with and without NCs. Workers who sign NCs earn higher wages, with an average gap of 21 log points. They also exhibit slightly longer job tenures and are 4 percentage points (13 percent) less likely to change main employers between 2017 and 2019. Since NCs legally restrict within-industry job mobility, we also examine within-industry transition rates and find that signers have 2 percentage points (17 percent) lower within-industry mobility.[17] Despite the higher wage levels, we find no significant relationship between signing a non-compete and wage growth or formal training in the cross-section.[18]

There are also notable differences in the types of workers who report having NCs. Non-compete signers tend to have characteristics associated with higher earnings: 52 percent hold a bachelor's degree or higher (compared to 42 percent among non-signers), and they score higher on the ASVAB, a standardized test assessing science, math, and language skills that we use as a proxy for cognitive ability. These workers are more likely to perform tasks involving mathematics, leadership, and problem solving. They are also less likely to be unionized and more likely to have negotiated over wages. Compared to non-signers, non-compete signers are more likely to be male and less likely to identify as Black or Hispanic. However, we find no significant differences in job satisfaction or firm size across the two groups.

[17] It is worth noting that within-industry mobility accounts for only about one-third of all job changes for both groups. This finding is consistent with Parent (2000), who shows using NLSY79 that roughly two-thirds of job moves occur across one-digit industries. The frequency of between-industry job mobility is also documented in Neal (1999) and Kambourov and Manovskii (2008). The prevalence of inter-industry transitions, especially among younger and more mobile workers, suggests that NCs may have limited effects on overall job mobility.

[18] Unlike the firm-level investment measures used in Shi (2023), we assess training at the individual level. Our sample is also approximately 10 years younger, with a mean age of 35 compared to 45 in Shi (2023). Nevertheless, both studies report similar differences in job tenure between workers with and without NCs: 0.12 years in our sample versus 0.10 years in hers.

Table 2: Estimated Effects of NCs using the 2017 Cross-Section

Panel 1: Wages and Wage Growth

Dependent Variables:	Log(Wage)			Wage Growth		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
1(NC)	0.211***	0.144***	0.081***	0.009	0.007	0.004
	(0.027)	(0.022)	(0.024)	(0.014)	(0.014)	(0.018)
Controls	None	Basic	Advanced	None	Basic	Advanced
Weighted Dependent Variable Mean	3.04	3.04	3.04	0.088	0.088	0.088
Fit statistics						
Observations	4,968	4,836	3,141	4,968	4,836	3,141
R^2	0.017	0.296	0.456	0.0001	0.0005	0.026

Panel 2: Training

Dependent Variables:	1(Any Training)			1(Emp Paid for Training)		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
1(NC)	-0.019	-0.025*	-0.017	-0.018*	-0.026**	-0.022
	(0.013)	(0.013)	(0.017)	(0.010)	(0.011)	(0.014)
Controls	None	Basic	Advanced	None	Basic	Advanced
Weighted Dependent Variable Mean	0.112	0.112	0.112	0.071	0.071	0.071
Fit statistics						
Observations	4,968	4,836	3,141	4,968	4,836	3,141
R^2	0.0005	0.007	0.048	0.0006	0.012	0.063

Panel 3: Job Mobility

Dependent Variables:	Tenure (Yrs)			1(Job Mobility Between 2017-2019)		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
1(NC)	0.125	0.002	-0.267	-0.036*	-0.026	-0.032
	(0.197)	(0.198)	(0.234)	(0.020)	(0.020)	(0.024)
Controls	None	Basic	Advanced	None	Basic	Advanced
Weighted Dependent Variable Mean	5.08	5.08	5.08	0.304	0.304	0.304
Fit statistics						
Observations	4,884	4,836	3,141	4,968	4,917	3,177
R^2	0.000	0.017	0.083	0.0008	0.011	0.039

Notes: Standard errors are heteroskedasticity-robust. The sample restricts to individuals who report NC status and have real wages between 3 and 200 in 2017. Basic controls include sex, education, tenure, and potential experience. Advanced controls further add industry and occupation fixed effects, ASVAB percentile, and firm size. Tenure controls are not included in the job mobility panel. All regressions are weighted so as to be nationally representative. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

To assess whether the raw wage and mobility differences are driven by observable worker or job characteristics rather than NCs themselves, we estimate the following equation via Ordinary Least Squares

$$Y_i = \beta_0 + \beta_1 * NC_i + \beta_2 * X_i + \varepsilon_i \tag{8}$$

where Y_i is the outcome of interest for worker i, X_i is a vector of observable characteristics for the worker and their current job, and β_1 is the relationship between Y_i and NC usage. We consider dependent variables log wages in 2017, log wage growth, job tenure, indicators for whether the worker changed jobs between 2017 and 2019, whether the worker received formal training, and whether the employer paid for that training. For each outcome we estimate Equation (8) with no controls, "basic" controls which includes sex, education, tenures, and potential experience, and "advanced" controls which further adds ASVAB test score percentiles, firm size, and industry and occupation fixed effects.

We report the results in Table 2. The estimated cross-sectional wage gap between NC signers and non-signers declines as we add control variables, falling from 21.1 to 8.1 log points. This result suggests that a substantial portion of the raw wage gap reflects observable differences in characteristics that are positively associated with wages among NC signers. In contrast, the estimated relationships between NCs and other labor market outcomes, such as changing one's main employer, wage growth, formal training, and job tenure, remain largely stable as we introduce additional covariates. Table B3 presents analogous results using the 2019 cross-section, which are qualitatively similar to those in 2017. Overall, the conclusions from our descriptive relationships align with those reported in Rothstein and Starr (2022), who also study the characteristics of NC signers in the 2017 cross-section using NLSY97 data.

Although NC signers earn higher wages, we note that even in the fully saturated model specified in Equation (8) our estimates may still suffer from omitted variable bias. For instance, if workers who sign NCs have higher unobserved ability, our wage estimates would be upward biased. To address this concern, the following subsection introduces our preferred difference-in-differences strategy, which leverages within-worker variation over time to net out potential time-invariant unobservable differences between NC signers and non-signers.

3.2 Estimating Equations

To estimate the causal effects of signing an NC (NC), we adopt a stacked difference-in-differences (DiD) research design. This approach is well-suited to settings with staggered treatment timing, where each treated cohort requires its own control group. Rather than relying on a single pool of never-treated units—as in the estimator proposed by Callaway and Sant'Anna (2021)— the stacked DiD approach constructs cohort-specific panel datasets, each with its own treatment and control group, and then combines (or stacks) these datasets to estimate a single regression model with either dynamic or aggregated treatment effects. This design has been applied in numerous empirical contexts, including firm responses to liability risk (Gormley and Matsa 2011), minimum wage increases (Cengiz et al. 2019), and state-level changes in NC enforceability (Johnson, Lavetti, and Lipsitz 2023).

In our setting, the timing of NC adoption varies across individuals, and treatment is closely tied to job transitions. For each survey year c, we construct a cohort-specific panel dataset that includes only those who moved to a new job with known NC status in year c. The treated group consists of workers who report signing an NC for the first time in year c; the control group includes job movers in the same year who never sign an NC during the sample period. Denote G_c as the set of treated individuals in cohort c. We focus on cohorts $c \in \{2015, 2017, 2019, 2021\}$ and restrict to data from 2013–2021 to allow a sufficient post-treatment horizon without assuming long-run within-job stability in NC status.[19] We then stack the data across cohorts and estimate the following event-study specification:

$$Y_{itc} = \alpha_{ic} + \lambda_{tc} + \sum_{k \in \{-6+, -4, 0, 2, 4, 6\}} \beta^k d_{i,t+k,c} + \varepsilon_{itc} \tag{9}$$

where Y_{itc} is the outcome of interest for individual i at time t in cohort c, and $d_{i,t+k,c}$ is an event-time indicator equal to one for treated individuals $i \in G_c$ in year $t = c + k$.

For ease of interpretation and to increase precision, we also estimate a more aggregated model by collapsing the dynamic indicators into a single post-treatment dummy:

$$Y_{itc} = \alpha_{ic} + \lambda_{tc} + \beta^{Agg} d^{Agg}_{i,t,c} + \varepsilon_{itc} \tag{10}$$

where $d^{Agg}_{i,t,c}$ equals one for treated individuals in all periods $t \geq c$, and β^{Agg} captures the average post-treatment effect. Standard errors are clustered at the individual level.

This design has several advantages. First, the inclusion of individual-by-cohort fixed effects α_{ic} and time-by-cohort fixed effects λ_{tc} ensures that workers treated in different periods are not inappropriately used as controls, addressing the "bad comparison" problem highlighted in the recent DiD literature (e.g. Baker, Larcker, and Wang 2022; Sun and Abraham 2021; Callaway and Sant'Anna 2021). Second, by design, our approach compares job movers to job movers, addressing a key challenge in this context. Because we only observe NC status when workers transition to

[19] We note that NC status is unobserved for jobs ending prior to 2017. This implies that treated workers in cohort 2015 are necessarily job stayers between 2015 and 2017. We impose the same restriction on the control group. Unobserved pre-2017 NC status also implies that some of the jobs held prior to year c for both the treatment and control group may have had an NC. We confirm our results are not sensitive to restricting to later cohorts that are unaffected by this issue in Section 4.4.2.

a new job, any change in treatment status (e.g. from $NC_{i,t-2} = 0$ to $NC_{i,t} = 1$) is necessarily tied to job mobility.[20] Since job changes are often associated with changes in wages, training, and other labor market outcomes, using all never-treated workers as a pooled control group would confound the effects of NCs with the effects of job mobility. By defining cohort-specific control groups of other job movers, our design ensures a more appropriate comparison. Finally, the inclusion of individual-cohort fixed effects allows us to control for time-invariant unobservable characteristics that may influence both selection into NCs and subsequent labor market trajectories.

3.3 Identifying Assumptions

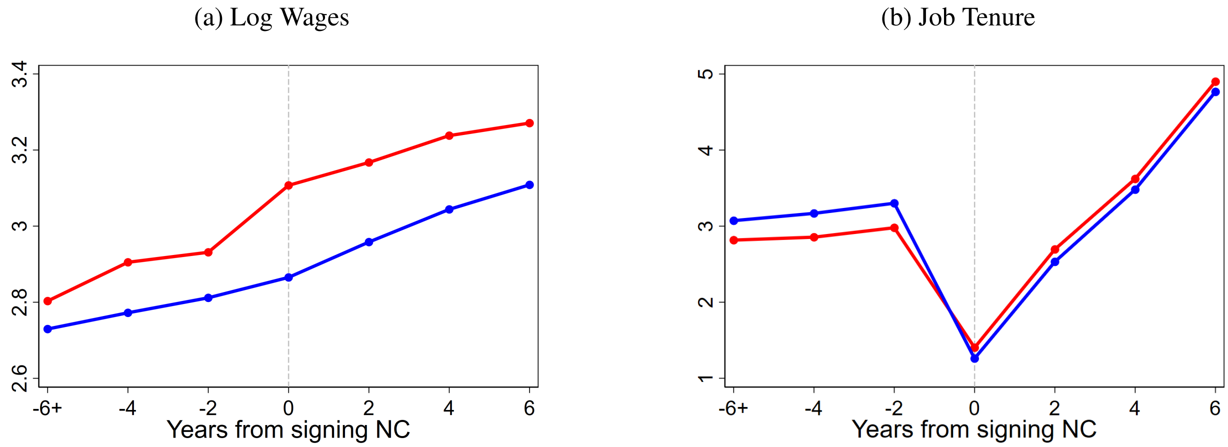
Our identification strategy relies on a parallel trends assumption that rules out selection into treatment based on time-varying unobservable characteristics. In particular, for the event-study coefficients $\hat{\beta}^k$, $k \geq 0$, from equation (9) to be interpreted as the causal effect of signing an NC, we assume that, within each cohort c, NC signers and their matched control group (job movers who never sign an NC during the sample period) would have experienced similar trends in potential outcomes in the absence of treatment.

Given that NC status is not randomly assigned but instead reflects joint decisions by workers and firms, this assumption may fail if selection into NCs is based on unobserved characteristics that vary over time. While the inclusion of individual fixed effects α_{ic} controls for selection based on time-invariant unobservables (e.g., inherent ability, preferences, or background), time-varying unobserved shocks could still bias our estimates. We now consider two types of time-varying unobservable factors that could threaten identification and explain why these are unlikely to bias our results.

The first concern is selection based on unobserved job characteristics. Certain types of jobs may be more likely to include NCs; for instance, jobs involving access to client relationships or managerial responsibilities. If these jobs also have inherently higher wages, our wage estimates may be upward biased. To address this concern, we re-estimate our models controlling for industry, occupation, and firm size decile fixed effects – characteristics strongly linked to firm productivity (Manning 2013). If unobserved job characteristics were driving the results, we would expect these controls to attenuate the estimated wage effects. Reassuringly, our results are nearly unchanged. Moreover, we show that NC signers are not disproportionately moving into jobs involving greater task complexity: they are no more likely to begin work involving management, problem-solving, or external-facing client work. These robustness checks suggest that our results are not driven by NC signers sorting into higher productivity firms.

[20]This feature is not merely an artifact of survey design—the NLSY97 does not ask about NC status across waves for the same job—but reflects the fact that NCs are typically signed upon starting a new job (Starr, Prescott, and Bishara 2021).

Figure 4: Means Relative to Event Time



Note: Figure reports means of log wages and job tenure aggregated over all cohorts in the stacked data. See text for data construction. Red lines correspond to NC signers (treatment group) and blue lines to non-NC signers (control group).

The second concern is selection based on unobserved worker characteristics that change over time. For example, workers may experience positive shocks – such as earning a new credential, receiving strong performance reviews, or gaining reputation – that are observed by employers but not the econometrician. Such events could potentially increase the likelihood of sorting into NC-covered jobs (e.g., through promotions or matching with more selective employers), while also increasing wages independently of NCs. In this case, the NC treatment indicator d_{itc} would be correlated with the error ε_{itc}, biasing estimates upward. While we cannot directly observe these time-varying shocks, we present several pieces of evidence suggesting that they are unlikely to bias our results. First, if such shocks occurred, we would expect NC signers to experience faster wage growth prior to signing. However, our event study plots and group-level means (Figure 4) show no such pre-trends. Second, if selection reflected improved job match quality, we would expect observable shifts in job composition. The fact that NC signers are not sorting into jobs requiring more complex tasks and that our results hold when controlling for job-level characteristics such as occupation, industry, and firm size, suggests that this form of selection is not driving our estimates.[21] As further robustness, we also try alternative empirical specifications, such as the standard two-way fixed effects estimator or using the later-treated as the control group. We leave the details of these exercises and their results to Section 4.4.3, but note here that our results are highly robust in each case.

[21] Note also that recent work by Ghanem, Sant'Anna, and Wüthrich (2022) and Marx, Tamer, and Tang (2024) demonstrate that parallel trends can still be justified in settings with selection into treatment based on time-invariant and time-varying unobservables, but doing so requires additional assumptions on the time-series properties of the error term that depend on the nature of the underlying selection mechanisms.

4 Results

4.1 The Effect of Signing an NC on Labor Market Outcomes

Figure 5 presents our main event-study estimates, with results reported separately for log wages and job tenure. NCs significantly raise wages upon signing, with the effect diminishing over time: wages increase by 9.9 log points in the year of signing and remain 4.7 log points higher six years later. This pattern mirrors descriptive findings in Shi (2023) among executives and suggests that while NC signers receive an immediate wage premium, their subsequent wage growth is slightly slower, averaging about 1 log point less per year. Signing an NC also leads to longer job tenures: we estimate an initial increase of 0.27 years (roughly 3 months), growing to 0.49 years (6 months) six years after signing. These results highlight the retention effect of NCs, in line with our theoretical model.

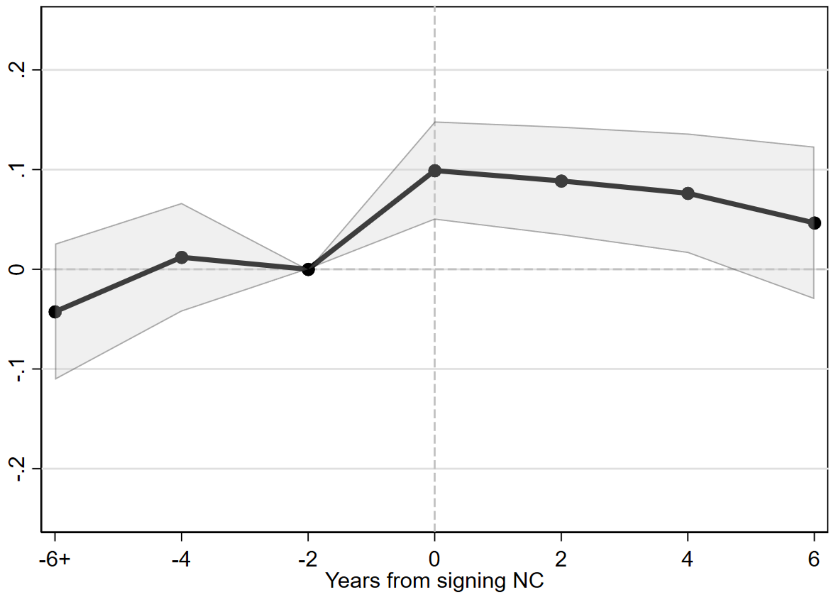
Table 3 reports aggregated estimates from equation (10), which improves statistical precision and facilitates the comparison of results across multiple outcome variables. NCs are associated with a 9.4 log point increase in wages, a 0.29 year increase in job tenure, and a 3.6 percentage point decline in the biannual probability of changing main employers. The wage effect is statistically significant at the 1% level and the mobility effects are significant at the 5% level. However, we find no significant effect on within-industry job mobility due to limited statistical power: only 150 NC signers change employers after signing, and fewer than 50 do so within the same industry.

The magnitude of these effects is economically meaningful. A 9.4 log point wage gain is roughly equivalent to the return to an additional year of education (Card 1999), or two years of typical wage growth in our sample. Similarly, the decline in job mobility corresponds to a 12% reduction relative to the 2017 mean, and the increase in tenure represents about a 6% rise. Beyond wages and mobility, we also investigate the effect of signing an NC on other labor market outcomes, including hours, job satisfaction, and employer-provided training in Table 3. The most noteworthy result is the absence of any significant effect of NCs on formal or employer-paid training. Only 11% of workers report receiving formal training in 2017, suggesting that this measure likely overlooks informal or on-the-job learning (e.g. Mincer 1962). As such, the null finding does not rule out the possibility that NCs facilitate investment through other channels.

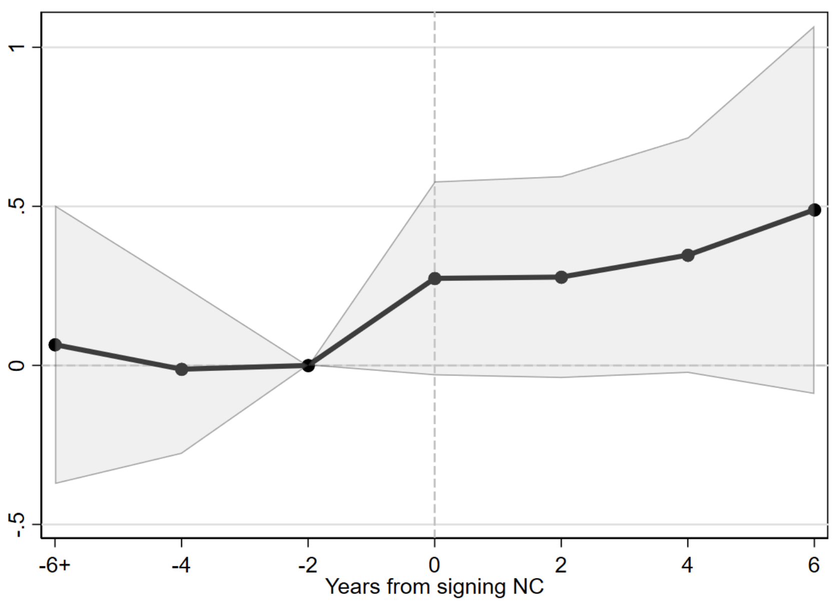
While formal training rates do not significantly differ between groups, the fact that NC signers continue to earn higher wages even six years after signing, on average, suggests that NCs lead to productivity-enhancing investment. If NCs do not encourage investment but instead function purely through a compensating differential, then we would expect to see a one-time shift in the timing of compensation: workers would receive higher earnings in the period of signing, but lower earnings in subsequent periods (e.g. Corollary 2). However, the persistence of a 4.7 log point wage premium six years after signing suggests that NCs raise worker productivity, likely by encouraging

Figure 5: The Dynamic Effects of Signing an NC

(a) Log Wages



(b) Job Tenure



Note: Estimates are from stacked difference-in-differences estimation (equation (9) in the text) over a bi-annual sample period of 2013-2021 and using cohorts $c \in \{2015, 2017, 2019, 2021\}$. The treatment group for cohort c are those who we observe first signing an NC in year c. The control group consists of workers who never held a NC during the event window and who also changed jobs between year c and the preceding survey year. Standard errors are clustered by worker and confidence intervals are reported at the 95% level.

Table 3: The Aggregate Effects of Signing an NC

(a) Wages and Mobility

	(1) Log Wages	(2) Tenure	(3) Change Main Emp.	(4) Change Main Emp. Within Ind.
Treat × Post	0.094***	0.287**	-0.036**	0.006
	(0.022)	(0.126)	(0.016)	(0.018)
Observations	22394	22040	21614	22004
Dependent Variable Mean	2.888	2.692	0.458	0.165
Unique Treated Workers	682	680	681	679
Unique Control Workers	3300	3263	3296	3285
R^2	0.770	0.588	0.598	0.388

(b) Other Outcomes

	(1) Hours/Wk	(2) Job Dissat.	(3) Training	(4) Employer-Paid Training
Treat × Post	1.025	0.026*	-0.023	-0.022
	(0.624)	(0.016)	(0.017)	(0.015)
Observations	22159	17686	22394	22394
Dependent Variable Mean	37.950	0.072	0.130	0.078
Unique Treated Workers	682	636	682	682
Unique Control Workers	3293	3039	3300	3300
R^2	0.511	0.401	0.459	0.455

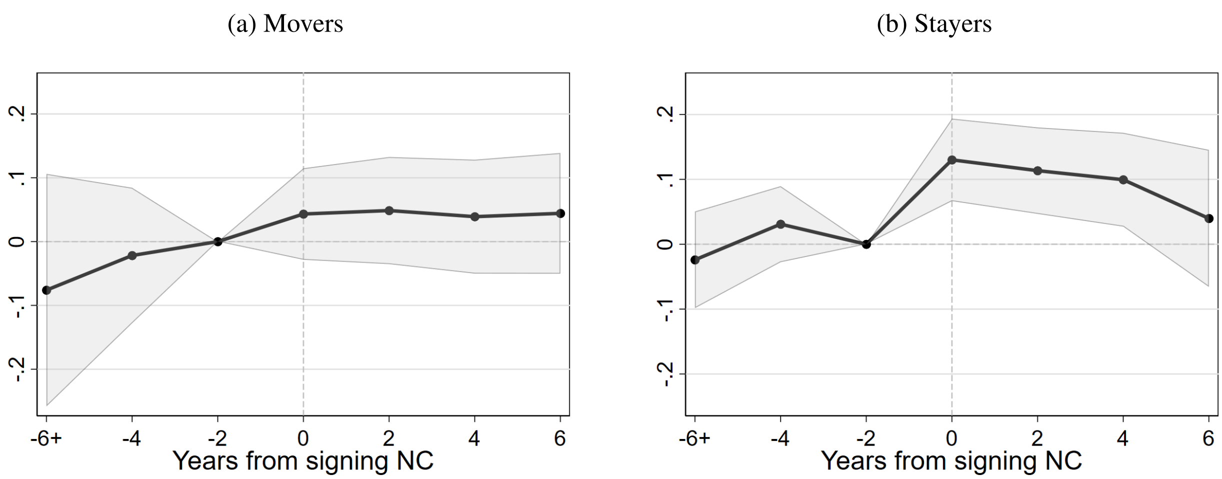
Notes: This table reports estimates from stacked difference-in-differences estimation, aggregated over post-treatment years, over a bi-annual sample period of 2013-2021 and using cohorts $c \in \{2015, 2017, 2019, 2021\}$. The treatment group for cohort c are those who we observe first signing an NC in year c. The control group consists of workers who never held a NC during the event window and who also changed jobs between year c and the preceding survey year. Job mobility is defined as changing main employers between the current and preceding survey year. Standard errors are clustered by worker and reported in parenthesis. Significance codes: ***: 0.01, **: 0.05, *: 0.1.

firms to invest in skill development. This interpretation aligns with our broader theoretical framework which highlights the potential for NCs to increase worker productivity and joint surplus.

4.2 Movers vs. Stayers

In our theoretical framework, workers who sign NCs are still permitted to leave for non-industry competitors. For patient workers, however, a higher expected quit probability reduces firm investment and therefore wages. This theoretical result motivates an examination of whether the effects of NCs on wages differ for workers who stay in their NC-covered job versus those who leave. To do so, we split treated workers by their post-treatment job mobility. A treated-stayer is defined as a worker who signs an NC at time c and remains in that same job in all subsequent observed periods $t > c$. A treated-mover signs an NC at time c but changes employers at least once in the post-period. Both groups are compared to a common control group consisting of never-treated workers who also changed jobs at time c. Our results are robust to instead using mobility-matched controls (i.e. comparing treated-movers to control-movers and treated-stayers to control-stayers).

Figure 6: The Effect of Signing an NC: Movers vs. Stayers



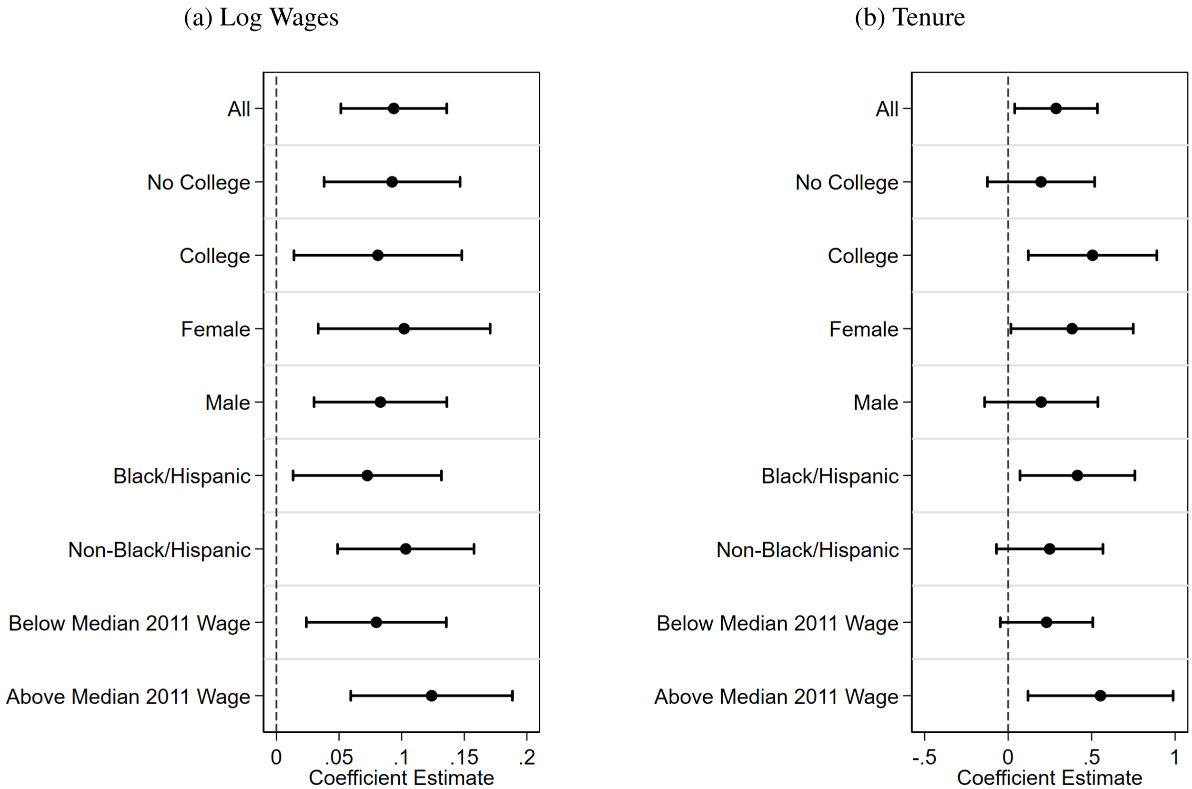
Note: Estimates are from stacked difference-in-differences estimation (equation (9)) using cohorts $c \in \{2015, 2017, 2019, 2021\}$ over a bi-annual sample period of 2013–2021. The treatment group consists of workers who sign an NC in year c. Movers change main employers at least once post-treatment. Stayers remain in their $t = c$ job throughout the post-period. The control group includes never-treated job movers. Standard errors are clustered by worker. 95% confidence intervals shown.

Figure 6 shows that the positive wage effects of NCs are driven primarily by stayers. Treated-movers earn 4.3 log points more than the control group at the time of signing and 4.4 log points more six years later, but these estimates are imprecise and there is no clear break at the point of treatment. In contrast, treated-stayers receive a 12.1 log point wage premium at signing and still earn 3.3 log points more six years later. This pattern aligns with the theoretical comparative statics in Proposition 4. Firms anticipate a higher probability of quit when a worker's outside option distribution is more favorable (i.e., when λ is low), and accordingly invest less in those matches. Workers expected to stay receive higher investment and, correspondingly, higher wages. These findings also reinforce the interpretation of our main results. The persistent wage premium observed in Figure 5 is not driven by treated workers who exit to better-paying opportunities but rather by those who remain. This result is notable given that the control group in both panels of Figure 6 consists of mobile workers unconstrained by NCs.

4.3 Heterogeneity by Worker Demographics

While NCs raise wages on average, an important question is whether these positive effects extend to all types of workers. This inquiry is particularly pertinent given recent policy discussions and

Figure 7: The Effect of Signing an NC: Heterogeneity Across Worker Groups

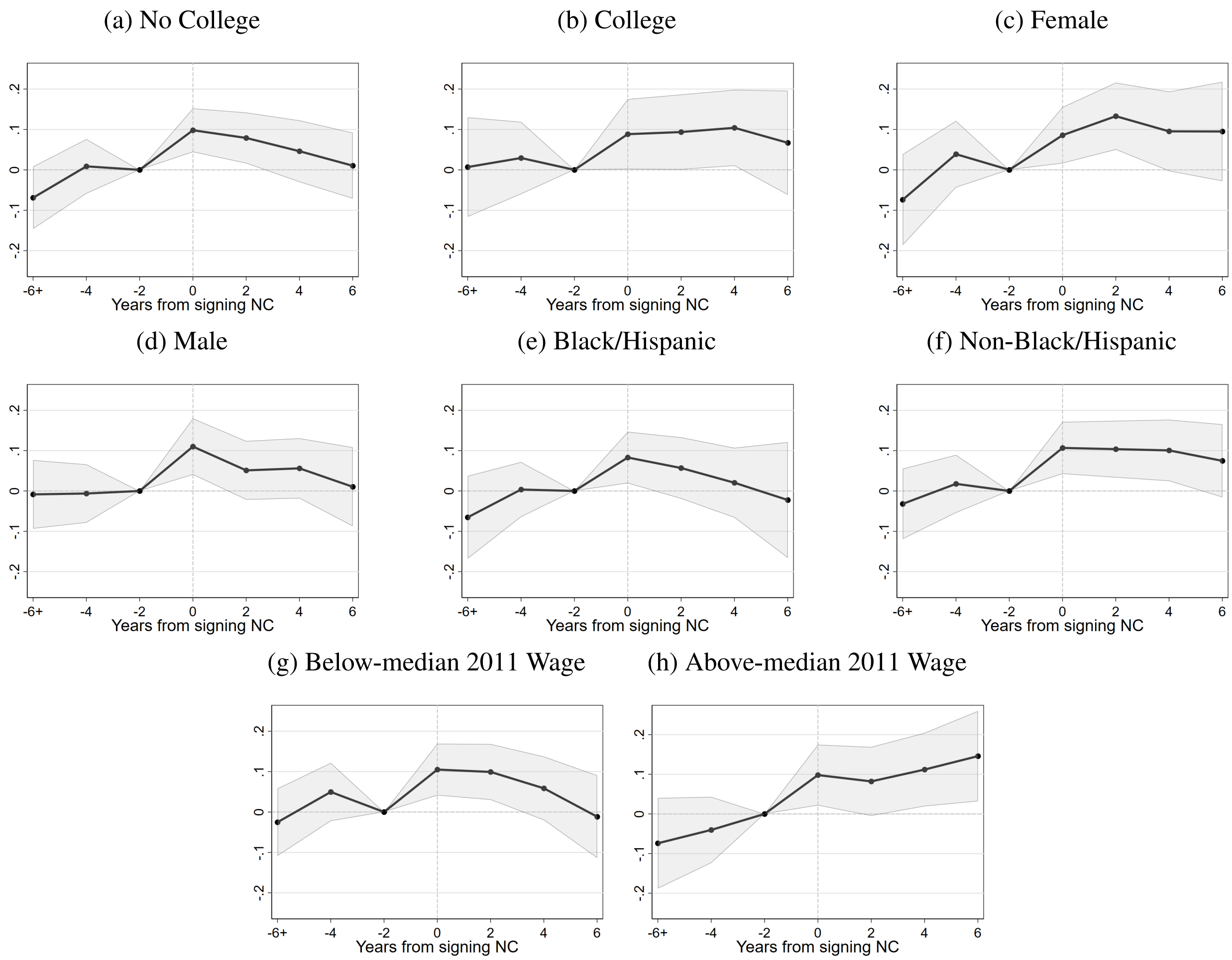


Note: Coefficient estimates are from stacked difference-in-differences estimation, aggregated over post-treatment years, using cohorts $c \in \{2015, 2017, 2019, 2021\}$ over a bi-annual sample period of 2013–2021. The control group consists of never-treated workers who also changed jobs at time c. Standard errors clustered by worker. 95% confidence intervals shown.

enacted bans on NCs for low-wage workers (e.g., Lipsitz and Starr 2022). Our theoretical model provides distinct predictions regarding such heterogeneity. It posits that NCs are most beneficial in situations where firm-sponsored, industry-specific investments are substantial, a scenario typically associated with higher-wage workers. In these cases, NCs can increase joint surplus and worker wages (Corollary 1) – a mechanism consistent with the persistent wage premium observed in our main analysis (Figure 5). However, our model also predicts a more exploitative scenario: workers with higher discount factors and lower returns on firm-provided investment may accept NCs even in the absence of significant firm investment (Proposition 8). This dynamic is more likely to apply to lower-wage workers, who may be more financially constrained and therefore value current income more. Motivated by these theoretical insights, we next explore how the effects of signing an NC vary across different worker subgroups.

To examine the varied impact of NCs, we categorize workers by education (college vs. no college), sex (male vs. female), race (Black/Hispanic vs. other), and pre-sample wages (above or below median wages in 2011). Figure 7 illustrates the aggregate effects of NCs for each of these

Figure 8: The Dynamic Wage Effects of Signing an NC by Subgroup



Note: Estimates are from stacked difference-in-differences estimation (equation (9)) using cohorts $c \in \{2015, 2017, 2019, 2021\}$ over a bi-annual sample period of 2013–2021. The control group consists of never-treated workers who also changed jobs between year c and the preceding survey year. Standard errors clustered by worker. 95% confidence intervals shown.

subgroups. The estimated wage increases range from 7.3 log points for Black/Hispanic workers to 12.4 log points for workers with above-median 2011 wages, and all effects are significantly positive. Similarly, the estimated tenure effects, while consistently positive, reveal notable differences across subgroups. For instance, college-educated workers experience a 0.51-year increase in tenure compared to 0.20 years for those without a college degree, and high-wage workers see a 0.55-year increase versus 0.23 years for low-wage workers. On the surface, this analysis offers little support for the idea that NCs systematically disadvantage certain subgroups.

However, these aggregate wage effects mask patterns in wage trajectories over time. We delve deeper by conducting our dynamic event study for each worker subgroup, revealing that while NCs lead to higher wage levels for all worker types over the first six years, significant differences emerge in their relative wage trajectories. Figure 8 illustrates these disparities, showing distinct wage-experience profiles across education, racial, and income groups. Workers with less than a college education, those who identify as Black or Hispanic, and those with low pre-sample wages all experience an upfront wage premium close to the average (approximately 10 log points). Yet, this initial gain is followed by sharp negative wage growth relative to their non-NC counterparts. In fact, for Black/Hispanic and low-income workers, the wage effect turns negative by year six. Conversely, college-educated, non-Black/Hispanic, and high-wage workers exhibit similar upfront wage premia but maintain flat or even increasing wage-experience profiles.

This analysis reveals that NCs appear to benefit higher wage, more educated workers, where the hold-up problem is likely more pronounced. For these higher-skill workers, systematically higher wages combined with stable or even increasing subsequent wage growth strongly contradicts the notion that NCs exploit them or trap them in lower-paying jobs. In contrast, the wage dynamics for workers with lower wages, less education, and those belonging to racial minority groups paint a different picture. The pattern of an upfront wage premium followed by sharp negative wage growth is more consistent with limited investments and higher initial wages reflecting a compensating wage differential. As such, our findings strongly suggest that policy interventions such as bans on NCs should be carefully tailored, perhaps specifically targeting lower-wage workers.

4.4 Robustness

4.4.1 Time-varying productivity as an omitted variable

Our primary identifying assumption is that the error terms in our core regressions are uncorrelated with non-compete signage, conditional on our fixed effect controls. Since we already control for worker fixed effects, our identifying assumption rules out unobserved, time-varying shocks that are simultaneously correlated with NC signage and labor market outcomes, such as wages and job mobility.

We see two potential violations of this identifying assumption. First, workers who sign NCs may join higher-productivity firms that would have paid higher wages even without a non-compete clause in the contract. Second, workers may experience shocks to their real or perceived productivity that lead them to sign an NC and that would have resulted in higher wages even without one. These time-varying unobservables introduce a potential omitted variables problem that could generate upward bias in our estimated wage effects. While our data limit our ability to control for these unobservables directly, we conduct several robustness checks to address these potential biases.

Our first robustness check is to re-estimate our aggregate effects from Table 3, progressively adding fixed effects for industry, occupation, and firm size decile. Industry and occupation fixed effects account for the possibility that NCs are more prevalent in certain high-paying sectors. Firm size is a well-established proxy for firm productivity in labor market models (e.g. Manning 2013), and we confirm its strong correlation with wages in the NLSY97 data (Figure B1). Our findings, presented in Figure B2, compare our baseline estimates against those obtained with the sequential inclusion of these detailed controls. Our analysis reveals that controlling for these job-level characteristics has minimal impact on our results. The estimated wage effect, for instance, only slightly decreases from 9.4 to 8.5 log points in the most comprehensive model (Panel A). Similarly, our job mobility estimates remain robust to these additional controls (Panels B and C). The tenure effect shifts modestly from 0.29 to 0.24 years, and the impact on the rate at which workers change main employers changes from -3.6 to -4.1 percentage points.

As a second robustness exercise, we compare how the task content of a worker's job changes for NC signers relative to non-signers. Starting in 2017, the NLSY97 asks workers about the task content of their jobs, from which we construct indicator variables based on whether the job involves frequent (i) short and repetitive tasks, (ii) physical tasks, (iii) management or supervision, (iv) problem solving, (v) math, (vi) reading long documents, or (vii) in-person contact with external people. Using the 2019 and 2021 cohorts, we estimate our aggregate stacked difference-in-differences regression (Equation 10) using each of the task-indicator variables as outcome variables. The estimated coefficients capture the extent to which workers moving into jobs with an NC change tasks in a way that is systematically different from those moving into a job with no NC. Our findings show no significant changes in task content between NC signers and non-signers (Figure B3).

If the wage premium we observe is driven by NC signers systemically moving into higher-productivity jobs, we would expect to see job level controls, such as the sector and size of the firm, mitigating our estimates. Similarly, if NC signage is correlated with between-firm promotions into higher paying jobs, such as those induced by worker productivity shocks, we would expect to see systematic changes in the types of tasks the worker is performing. The fact that neither of these predictions bear out in the data, coupled with the observation that NC signers have similar pre-signage wage growth, give us confidence that our baseline estimates are not biased by unobserved, time-varying characteristics positively associated with both wages and NC status.

4.4.2 Data limitations on NC usage

The structure of the non-compete questions in the NLSY97 survey requires us to place assumptions on the timing of NC signage. First, since we only observe NC status starting in 2017 and do not observe changes to NC status within the same job, we assume that the NC was signed at the beginning of the employment relationship. This assumption imposes that NC status does not change with job tenure. A violation of this assumption would arise if non-compete clauses were frequently signed later on in an employment relationship – for instance, if NC signage is tied to promotions within the same job. However, existing resarch by Starr, Prescott, and Bishara (2021) indicates that such instances are rare, with the vast majority of NCs being signed at the beginning of the employment relationship.

A related data limitation is the absence of NC status in the pre-period for cohorts 2015 and 2017. To formally assess the impact of this limitation, we conduct a robustness check by sequentially removing these cohorts from our sample. Specifically, we re-calculate our aggregate estimates separately using (1) only years 2015-2021 and cohorts 2017-2021 and (2) only years 2017-2021 and cohorts 2019-2021. The latter restriction is particularly valuable as it ensures we only utilize observations where NC status is directly observed both before and after a job move, providing more transparent estimates.

The results of this exercise, displayed in Figure B4, are reassuring. We find that our estimated wage and job mobility rate effects remain largely unchanged; if anything, they tend to increase slightly in magnitude as we remove the 2015 and 2017 cohorts. Similarly, the point estimates for job tenure are nearly identical across these restricted samples. This consistency demonstrates that our findings are not driven by measurement error in NC status and also indicates the stability of our results across different cohorts.

Finally, it is important to acknowledge that NCs are often bundled with other post-employment restrictions, such as non-disclosure agreements (Balasubramanian, Starr, and Yamaguchi 2024). To the extent that this bundling occurs within our data, our estimates should be interpreted as identifying the causal effects of this broader set of restrictions, rather than NCs in isolation.

4.4.3 Alternative Estimation Methods: Later-Treated and TWFE

Although our main specification with individual fixed effects accounts for selection into non-compete status based on time-invariant characteristics, concerns may remain that NC signers differ fundamentally from non-signers. To further probe this issue, we modify our control group to use "later-treated" workers as controls. Specifically, we re-estimate equation (9), but now define the control group for each cohort c as job-movers in the same year who do not yet have an NC but go on to sign one in a later survey wave ($t > c$). This specification compares NC signers to future NC signers, leveraging only the timing of contract adoption. The identifying assumptions remain similar to those in our baseline specification. Results are shown in Figure B5.

Relative to our baseline stacked event-study specification, we observe a larger initial wage effect when using later-treated controls, followed by more negative wage growth. This pattern is expected: individuals in the control group are themselves on track to sign NCs and thus likely to experience wage increases around their own signing dates. As a result, the treated group's wage growth appears weaker after time zero, relative to the baseline specification. While this pattern complicates interpretation of post-treatment effects, the initial wage gain reinforces that our baseline estimates are not driven by unobserved differences between NC signers and non-signers.

We also estimate two specifications using a standard two-way fixed effects (TWFE) approach, which departs from our stacked design and includes all workers, not just job movers. Specifically, we estimate:

$$w_{it} = \alpha_i^a + \lambda_t^a + \beta^{TWFE-a} d_{it}^a + \varepsilon_{it}^a, \tag{11}$$

$$w_{it} = \alpha_i^{na} + \lambda_t^{na} + \beta^{TWFE-na} d_{it}^{na} + \varepsilon_{it}^{na}, \tag{12}$$

where w_{it} denotes log wages, α_i^j are individual fixed effects, λ_t^j are year fixed effects, and ε_{it}^j is the error term for specification $j \in \{a, na\}$. The variable d_{it}^a is an absorbing treatment indicator equal to one from the first observed year of NC signage onward. In contrast, d_{it}^{na} is a non-absorbing treatment indicator, capturing only current NC status and allowing for transitions into and out of NC status within individuals. We limit the *na* model to the 2017–2021 period, when both entry and exit from NC jobs can be directly observed.

The key distinction between these models and our baseline is the broader control group: in TWFE, all non-NC workers serve as controls, rather than the never-treated job movers used in our stacked design. Despite this difference, the point estimates from estimating (11) yields results that closely mirror our main findings (Figure B6). The estimated aggregate wage effect is 9.5 log points, virtually identical to our baseline estimate of 9.4 log points. The subgroup patterns also align: college-educated, non-Black/Hispanic, and high-wage workers experience larger gains. Estimating the parameters from (12), which uses current NC status, yields a smaller but still statistically significant average wage effect of 5.8 log points (Figure B6b). Again, we see meaningful heterogeneity: 8.9 log points for high-wage workers compared to 4.2 log points for low-wage workers. These estimates further support the core conclusion that NCs are associated with higher wages, particularly for more advantaged worker groups.

5 Conclusion

Economists have long been interested in the factors that promote human capital development, but the market for employer-provided training suffers a well-known failure: employers are reluctant to provide transferable skills if they must later pay for the worker's increased productivity (e.g. Becker 1962; Acemoglu and Pischke 1999). Our primary theoretical contribution is an asymmetric information model which shows that NCs can mitigate this problem by encouraging investment in industry-specific training, but at the cost of generating ex-post allocative inefficiencies. However, this same model demonstrates a critical distinction: for lower-wage workers who may have high discount factors and low returns on training, the non-compete agreement will be used to raise firm profits, even if the resulting increase in investment is minimal. In contrast, our renegotiation model, which applies more directly to executives, suggests that when buyout payments are unconstrained, NCs can be structured to achieve efficient investments and mobility.

Relative to previous research that has focused on the causal effects of non-compete regulation, which generally finds that higher enforcement leads to lower wages (e.g. Johnson, Lavetti, and Lipsitz 2023), our study is one of the first to use a quasi-experimental design to isolate the causal effects of signing an NC itself. As expected, we find that signing a non-compete lowers job mobility, raising job tenures by 6% and lowering rates of job-to-job transitions by 12%. Our findings on wages, however, reveal significant heterogeneity across the workforce. For high-wage, White, and college-educated workers, signing a non-compete leads to an immediate and persistent wage increase of about 10%. In stark contrast, for lower-wage, Black/Hispanic, and non-college-educated workers, the agreement presents a trade-off: while it leads to an immediate increase in wages of a similar magnitude, this initial gain comes at the cost of lower subsequent wage growth. Our results therefore caution against a blanket ban on the enforcement of NCs, favoring a more targeted approach focusing on lower-wage workers.

Although signing an NC results in higher total career earnings on average, the source of the underlying productivity gain remains a puzzle. Despite theoretical predictions that NCs should encourage employer investment in worker skills, we find no evidence of increased formal training for those who sign. This observation raises the question of whether non-compete signers become more productive through less observable channels, such as receiving more intensive on-the-job mentoring or building stronger, more collaborative relationships with managers. Understanding these informal mechanisms is crucial for providing deeper insight into how NCs influence long-term worker productivity and career trajectories.

References

Acemoglu, Daron and Jörn-Steffen Pischke (1999). "The structure of wages and investment in general training." *Journal of political economy* 107.3, 539–572.

Aghion, Philippe and Patrick Bolton (1987). "Contracts as a Barrier to Entry." *The American economic review*, 388–401.

Baker, Andrew C., David F. Larcker, and Charles C.Y. Wang (2022). "How much should we trust staggered difference-in-differences estimates?" *Journal of Financial Economics* 144.2, 370–395.

Balasubramanian, Natarajan, Evan Starr, and Shotaro Yamaguchi (2024). "Employment restrictions on resource transferability and value appropriation from employees." *Strategic Management Journal* 45.12, 2519–2547.

Becker, Gary S. (1962). "Investment in Human Capital: A Theoretical Analysis." *Journal of Political Economy* 70.5, 9–49.

Callaway, Brantly and Pedro H.C. Sant'Anna (2021). "Difference-in-Differences with multiple time periods." *Journal of Econometrics* 225.2, 200–230.

Card, David (1999). "The causal effect of education on earnings." *Handbook of labor economics* 3, 1801–1863.

— (2022). "Who Set Your Wage?" *American Economic Review* 112.4, 1075–1090.

Cengiz, Doruk et al. (2019). "The Effect of Minimum Wages on Low-Wage Jobs*." *The Quarterly Journal of Economics* 134.3, 1405–1454.

Coase, R. H. (1960). "The Problem of Social Cost." *The Journal of Law & Economics* 3, 1–44.

Cowgill, Bo, Brandon Freiberg, and Evan Starr (2024). "Clause and Effect: Theory and Field Experimental Evidence on Noncompete Clauses."

Deming, David J. (2017). "The Growing Importance of Social Skills in the Labor Market*." *The Quarterly Journal of Economics* 132.4, 1593–1640.

Feess, Eberhard and Gerd Muehlheusser (2003). "Transfer fee regulations in European football." *European Economic Review* 47.4, 645–668.

Ghanem, Dalia, Pedro H. C. Sant'Anna, and Kaspar Wüthrich (2022). "Selection and parallel trends."

Goodman-Bacon, Andrew (2021). "Difference-in-differences with variation in treatment timing." *Journal of Econometrics* 225.2, 254–277.

Gormley, Todd A. and David A. Matsa (2011). "Growing Out of Trouble? Corporate Responses to Liability Risk." *Review of Financial Studies* 24.8, 2781–2821.

Gottfries, Axel and Gregor Jarosch (2023). "Dynamic Monopsony with Large Firms and Noncompetes." w31965. National Bureau of Economic Research, w31965.

Grossman, Sanford J. and Oliver D. Hart (1986). “The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration.” *Journal of Political Economy* 94.4, 691–719.

Harris, Milton and Bengt Holmstrom (1982). “A Theory of Wage Dynamics.” *The Review of Economic Studies* 49.3, 315.

Hart, Oliver and John Moore (1988). “Incomplete Contracts and Renegotiation.” *Econometrica* 56.4, 755.

Hashimoto, Masanori (1981). “Firm-specific human capital as a shared investment.” *The American Economic Review* 71.3, 475–482.

Heckman, James J., Lance J. Lochner, and Petra E. Todd (2006). “Chapter 7 Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond.” *Handbook of the Economics of Education*. Vol. 1. Elsevier, 307–458.

Hellmann, Thomas and Veikko Thiele (2017). “Partner Uncertainty and the Dynamic Boundary of the Firm.” *American Economic Journal: Microeconomics* 9.4, 277–302.

Jeffers, Jessica S (2023). “The Impact of Restricting Labor Mobility on Corporate Investment and Entrepreneurship.” *The Review of Financial Studies* 37.1. Ed. by Manju Puri, 1–44.

Johnson, Matthew S., Kurt J. Lavetti, and Michael Lipsitz (2023). “The Labor Market Effects of Legal Restrictions on Worker Mobility.”

Kambourov, Gueorgui and Iourii Manovskii (2008). “RISING OCCUPATIONAL AND INDUSTRY MOBILITY IN THE UNITED STATES: 1968–97*.” *International Economic Review* 49.1, 41–79.

Kini, Omesh, Ryan Williams, and Sirui Yin (2021). “CEO Noncompete Agreements, Job Risk, and Compensation.” *The Review of Financial Studies* 34.10. Ed. by David Denis, 4701–4744.

Lavetti, Kurt, Carol Simon, and William D. White (2020). “The Impacts of Restricting Mobility of Skilled Service Workers: Evidence from Physicians.” *Journal of Human Resources* 55.3, 1025–1067.

Lawrance, Emily C. (1991). “Poverty and the Rate of Time Preference: Evidence from Panel Data.” *Journal of Political Economy* 99.1, 54–77.

Lipsitz, Michael and Evan Starr (2022). “Low-Wage Workers and the Enforceability of Noncompete Agreements.” *Management Science* 68.1, 143–170.

MacLeod, W Bentley and James M Malcomson (1993). “Investments, holdup, and the form of market contracts.” *The American Economic Review*, 811–837.

Manning, Alan (2013). *Monopsony in Motion: Imperfect Competition in Labor Markets*. Princeton University Press.

Marx, Philip, Elie Tamer, and Xun Tang (2024). “Parallel Trends and Dynamic Choices.” *Journal of Political Economy Microeconomics* 2.1, 129–171.

Meccheri, Nicola (2009). “A note on noncompetes, bargaining and training by firms.” *Economics Letters* 102.3, 198–200.

Mincer, Jacob (1962). “On-the-Job Training: Costs, Returns, and Some Implications.” en. *Journal of Political Economy* 70.5, Part 2, 50–79.

Neal, Derek (1999). “The Complexity of Job Mobility among Young Men.” *Journal of Labor Economics* 17.2, 237–261.

Pakes, Ariel and Shmuel Nitzan (1983). “Optimum contracts for research personnel, research employment, and the establishment of rival enterprises.” *Journal of labor economics* 1.4, 345–365.

Parent, Daniel (2000). “Industry-specific capital and the wage profile: Evidence from the national longitudinal survey of youth and the panel study of income dynamics.” *Journal of Labor Economics* 18.2, 306–323.

Posner, Eric A, George G Triantis, and Alexander J Triantis (2004). “Investing in human capital: The efficiency of covenants not to compete.” *U Chicago Law & Economics, Olin Working Paper* 137, 01–08.

Rothstein, Donna and Evan Starr (2022). “Noncompete agreements, bargaining, and wages.” *Monthly Labor Review*.

Shah, Anuj K., Sendhil Mullainathan, and Eldar Shafir (2012). “Some Consequences of Having Too Little.” *Science* 338.6107, 682–685.

Shavell, Steven (1984). “The Design of Contracts and Remedies for Breach.” *The Quarterly Journal of Economics* 99.1, 121.

Shi, Liyan (2023). “Optimal regulation of noncompete contracts.” *Econometrica* 91.2, 425–463.

Shy, Oz and Rune Stenbacka (2023). “Noncompete agreements, training, and wage competition.” *Journal of Economics & Management Strategy* 32.2, 328–347.

Spier, Kathryn E and Michael D Whinston (1995). “On the efficiency of privately stipulated damages for breach of contract: entry barriers, reliance, and renegotiation.” *The RAND Journal of Economics*, 180–202.

Starr, Evan P., J.J. Prescott, and Norman D. Bishara (2021). “Noncompete Agreements in the US Labor Force.” *The Journal of Law and Economics* 64.1, 53–84.

Sun, Liyang and Sarah Abraham (2021). “Estimating dynamic treatment effects in event studies with heterogeneous treatment effects.” *Journal of Econometrics* 225.2, 175–199.

Topel, R. H. and M. P. Ward (1992). “Job Mobility and the Careers of Young Men.” *The Quarterly Journal of Economics* 107.2, 439–479.

Zeldes, Stephen P. (1989). “Consumption and Liquidity Constraints: An Empirical Investigation.” *Journal of Political Economy* 97.2, 305–346.

A Appendix

A.1 Social Planner's Solution: Existence, Uniqueness, Comparative Statics

We show that for every parameter set (r, ρ, λ) where $r > \rho$, the surplus function $\mathscr{S}(i) = -\frac{1}{2}i^2 + ri + \frac{e^{-\lambda\Delta i}}{\lambda}$ admits exactly one maximizer $i^\star > 0$. The first derivative of the surplus function is $\mathscr{S}'(i) = r - i - \Delta e^{-\lambda\Delta i}$. At the origin, the derivative is $\mathscr{S}'(0) = r - \Delta = \rho > 0$, implying that zero investment is never optimal. As $i \to \infty$, the exponential term vanishes and $\mathscr{S}'(i) \sim r - i \to -\infty$. Since $\mathscr{S}'(i)$ is continuous and changes sign from positive to negative, it must equal zero at least once for some $i > 0$.

To prove uniqueness, we examine the second derivative, $\mathscr{S}''(i) = -1 + \lambda\Delta^2 e^{-\lambda\Delta i}$. This second derivative is strictly decreasing in i.

- If $\lambda\Delta^2 \leq 1$, then $\mathscr{S}''(i) < 0$ for all $i \geq 0$. This means $\mathscr{S}(i)$ is globally strictly concave, and the critical point identified by the first-order condition is the unique global maximizer.

- If $\lambda\Delta^2 > 1$, then $\mathscr{S}''(i)$ starts non-negative at $i = 0$ and crosses zero exactly once at an inflection point $i_0 > 0$. For all $i > i_0$, the function $\mathscr{S}(i)$ is strictly concave. Because $\mathscr{S}'(0) = \rho > 0$ and $\mathscr{S}'(i)$ is non-decreasing on the interval $[0, i_0]$ (since $\mathscr{S}''(i) \geq 0$ on this interval), any solution to $\mathscr{S}'(i) = 0$ must lie in the region (i_0, ∞) where the function is strictly concave.

Thus, in all cases, there is a single critical point which is the unique global maximizer, $i^\star$.

LEMMA 2. *At the optimal investment level $i^\star$, the surplus function must be locally concave. We prove that the second-order condition is strictly satisfied, i.e., $\mathscr{S}''(i^\star) < 0$.*

Proof. Suppose for contradiction that $\mathscr{S}''(i^\star) = -1 + \lambda\Delta^2 e^{-\lambda\Delta i^\star} \geq 0$. As shown in Appendix A.1, the function $\mathscr{S}''(i)$ is strictly decreasing in i. This implies that for all $i \in [0, i^\star)$, it must be that $\mathscr{S}''(i) > \mathscr{S}''(i^\star) \geq 0$. Therefore, the first derivative $\mathscr{S}'(i)$ must be strictly increasing on the interval $[0, i^\star]$. This leads to a contradiction, since we know $\mathscr{S}'(0) = \rho > 0$ and $\mathscr{S}'(i^\star) = 0$. A function cannot start at a positive value and be strictly increasing to a value of zero. Hence, the premise is false and it must be that $\mathscr{S}''(i^\star) < 0$. ■

We now analyze how the optimal investment and quit probabilities respond to changes in the economic environment.

LEMMA 3 (Comparative Statics of Investment)**.** *The optimal investment $i^\star$ responds to parameter changes as follows: (i) it is strictly increasing in internal productivity, $\partial i^\star/\partial r > 0$; (ii) it is strictly increasing in the outside option parameter, $\partial i^\star/\partial\lambda > 0$; and (iii) its response to external productivity ρ is ambiguous, with $\partial i^\star/\partial\rho \gtrless 0$ if and only if $\lambda\Delta i^\star \lessgtr 1$.*

Proof. Let $\phi := \lambda\Delta i^\star$. Applying the implicit function theorem to Equation 2, we have $\partial i^\star/\partial x = -F_x/F_i$, where $F(i,x) = r - i - \Delta e^{-\lambda\Delta i}$. As shown in Lemma 2, the second-order condition ensures that the denominator $F_i = \mathscr{S}''(i^\star)$ is strictly negative. The signs of the comparative statics are therefore determined by the signs of the partial derivatives $F_x = \partial F/\partial x$:

$$\begin{aligned}
F_r &= 1 - e^{-\phi}(1 - \phi) > 0, \\
F_\lambda &= \Delta^2 i^\star e^{-\phi} > 0, \\
F_\rho &= e^{-\phi}(1 - \phi).
\end{aligned}$$

Since $F_i < 0$, the signs of $\partial i^\star/\partial r$ and $\partial i^\star/\partial\lambda$ are positive. The sign of $\partial i^\star/\partial\rho$ depends on the term $(1 - \phi)$, proving the proposition. ■

Higher internal productivity (r) and a less favorable distribution of outside options (higher λ, meaning lower mean $1/\lambda$) both unambiguously increase the incentive to invest. The effect of higher external productivity (ρ) depends on whether quits are common ($\phi < 1$) or rare ($\phi > 1$).

LEMMA 4 (Comparative Statics of the Quit Probability)**.** *The equilibrium quit probability, $q^\star = e^{-\lambda\Delta i^\star}$, is strictly decreasing in internal productivity r and in the outside option parameter λ. The effect of external productivity ρ is ambiguous.*

Proof. Let $\phi := \lambda\Delta i^\star$. The derivative is $dq^\star/dx = -q^\star(d\phi/dx)$, so its sign is opposite to that of $d\phi/dx = d(\lambda\Delta i^\star)/dx$.

- For r: $d\phi/dr = \lambda\Delta(\partial i^\star/\partial r) + \lambda i^\star > 0$. Thus, $dq^\star/dr < 0$.
- For λ: $d\phi/d\lambda = \lambda\Delta(\partial i^\star/\partial\lambda) + \Delta i^\star > 0$. Thus, $dq^\star/d\lambda < 0$.
- For ρ: $d\phi/d\rho = \lambda\Delta(\partial i^\star/\partial\rho) - \lambda i^\star$. The sign is ambiguous as it involves the difference of two terms, with $\partial i^\star/\partial\rho$ itself having an ambiguous sign.

■

A.2 Proof of Proposition 1

Proof. (i) Let the private separation threshold be $v_T^s(i_s) = w_s^*(i_s) - \rho i_s$, where $w_s^*(i_s)$ is the equilibrium wage. For the firm to find it profitable to retain the worker, the wage it offers must be less than the worker's output, $w_s^*(i_s) < ri_s$. Substituting this profitability constraint into the definition of the threshold directly yields the result:

$$v_T^s(i_s) = w_s^*(i_s) - \rho i_s < ri_s - \rho i_s = (r-\rho)i_s = v_{\text{eff}}(i_s).$$

Since the private threshold below which a worker stays is strictly lower than the socially efficient threshold, the market generates inefficient quits.

(ii) To prove under-investment, we compare the firm's Private Marginal Benefit of investment (PMB_s) with the Social Marginal Benefit (SMB). The firm chooses i_s^* such that $\text{PMB}_s(i_s^*) = i_s^*$, while the planner chooses i^* such that $\text{SMB}(i^*) = i^*$. We show that $\text{PMB}_s(i) < \text{SMB}(i)$ for all $i > 0$, which implies $i_s^* < i^*$.

The Social Marginal Benefit from the planner's first-order condition is:

$$\text{SMB}(i) = r - (r-\rho)e^{-\lambda(r-\rho)i}$$

The Private Marginal Benefit is the marginal increase in the firm's expected second-period profit from an additional unit of investment. The firm's expected profit for a given i and w is $E[\Pi_s] = (ri - w)(1 - e^{-\lambda(w-\rho i)})$. The PMB is the total derivative of this profit with respect to i, evaluated at the firm's optimal wage $w_s^*(i)$. By the Envelope Theorem, this simplifies to the partial derivative with respect to i:

$$\begin{aligned}\text{PMB}_s(i) &= \frac{d}{di}E[\Pi_s(i, w_s^*(i))] = \left.\frac{\partial E[\Pi_s]}{\partial i}\right|_{w=w_s^*(i)} \\ &= r\left(1 - e^{-\lambda(w_s^*-\rho i)}\right) - \lambda\rho(ri - w_s^*)e^{-\lambda(w_s^*-\rho i)}.\end{aligned}$$

The firm's marginal benefit is strictly lower than the social marginal benefit due to two problems:

1. **The Hold-Up Effect:** The second term in the PMB, $-\lambda\rho(ri - w_s^*)e^{-\lambda(w_s^*-\rho i)}$, represents a direct financial disincentive to invest. When the firm invests an additional unit, it also increases the value of

the worker's outside option by ρ, making separation more likely. This term quantifies the resulting loss: it is the profit margin lost on a quit, $(ri - w_s^*)$, multiplied by the increase in the quit probability caused by a marginal increase in investment. This leakage of surplus to the worker reduces the firm's incentive to invest.

2. **The Inefficient Separation Effect:** The firm anticipates the outcome from part (i)—that it will fail to retain the worker in states where retention is socially valuable. This lower probability of retention further depresses the firm's expected return on investment compared to the planner's.

Both forces unambiguously push the firm's private incentive to invest below the social incentive. Thus, for any level of investment i, we have $\text{PMB}_s(i) < \text{SMB}(i)$. Consequently, the spot market generates inefficiently low retention and investments. ∎

A.3 Necessary and Sufficient Conditions for a Non-Zero Wage with a Non-Compete

We analyze the conditions under which the firm offers a strictly positive wage, $w_1 > 0$, as part of an optimal contract with an NC. Let $\Sigma_1(w_1)$ denote the joint surplus. Since $\Sigma_1'(0) = 0$, any move from $w_1 = 0$ raises surplus only if $\Sigma_1''(0) > 0$. Equivalently, if we define $H(w_1) \equiv \frac{d\Sigma_1}{dw_1}(w_1)$, then $H(0) = 0$ and local convexity at zero requires $H'(0) > 0$.

Recall that the firm's investment schedule is

$$i_1(w_1) \;=\; r\big(1 - e^{-\lambda w_1}\big),$$

so in particular $i_1(0) = 0$ and hence $\Sigma_1(0) = 0$. The first-order condition for an interior optimum is

$$H(w_1) = (\beta - 1)\big(1 - e^{-\lambda w_1}\big) + \lambda\left(r\, i_1(w_1) - w_1\right) e^{-\lambda w_1},$$

with $H(0) = 0$.

LEMMA 5 (Condition for a Positive Wage with a Non-Compete)**.**

(a) A strictly positive equilibrium wage, $w_1^* > 0$, exists if and only if

$$\beta - 2 + \lambda r^2 \;>\; 0, \quad \textit{i.e.} \quad \beta > 2 - \lambda r^2.$$

(b) A sufficient condition for a positive wage for any $\beta \geq 0$ is

$$\lambda r^2 > 2.$$

Proof. Substitute $i_1(w_1) = r(1 - e^{-\lambda w_1})$ into $H(w_1)$:

$$H(w_1) = (\beta - 1)\big(1 - e^{-\lambda w_1}\big) + \lambda\left(r^2 - r^2 e^{-\lambda w_1} - w_1\right)e^{-\lambda w_1}.$$

Differentiate with respect to w_1:

$$\begin{aligned} H'(w_1) = {} & \lambda(\beta - 1)e^{-\lambda w_1} + \lambda\left(r^2 \lambda e^{-\lambda w_1} - 1\right)e^{-\lambda w_1} \\ & + \lambda\left(r^2 - r^2 e^{-\lambda w_1} - w_1\right)\left(-\lambda e^{-\lambda w_1}\right). \end{aligned}$$

Evaluating at $w_1 = 0$:

$$\begin{aligned} H'(0) &= \lambda(\beta - 1) + \lambda(\lambda r^2 - 1) + \lambda(r^2 - r^2 - 0)(-\lambda) \\ &= \lambda\beta - \lambda + \lambda^2 r^2 - \lambda \\ &= \lambda\big(\beta - 2 + \lambda r^2\big). \end{aligned}$$

Since $\lambda > 0$, $H'(0) > 0$ iff $\beta - 2 + \lambda r^2 > 0$, proving part (a).

For part (b), we require $\beta > 2 - \lambda r^2$ to hold even for the minimum possible value of patience, $\beta = 0$. This gives the condition $0 > 2 - \lambda r^2$, which simplifies to $\lambda r^2 > 2$. This ensures $H'(0) > 0$ for all $\beta \geq 0$, completing the proof. ■

A.4 Proof of Proposition 3

Proof. Let the optimal investments be the roots of the first-order conditions (FOCs) defined as Marginal Benefit - Marginal Cost.

- For the social planner: $F_P(i) \equiv \big(r - \Delta e^{-\lambda\Delta i}\big) - i = 0$
- For the firm: $F_F(i) \equiv \big(r - re^{-\lambda ri}\big) - i = 0$

The firm chooses i_1 such that $F_F(i_1) = 0$. By the second-order condition for a maximum, the derivative of the firm's FOC must be negative at the optimum, so $\partial F_F/\partial i < 0$. This means $F_F(i)$ is a decreasing function of investment i. Because $F_F(i)$ is decreasing, we can determine the sign of the investment distortion by evaluating the sign of $F_F(i^*)$. If $F_F(i^*) < 0$, then $i_1 < i^*$ (under-investment). If $F_F(i^*) > 0$, then $i_1 > i^*$ (over-investment).

We evaluate the firm's FOC at the social optimum i^*:

$$F_F(i^*) = r - re^{-\lambda ri^*} - i^*$$

From the planner's FOC, we know $F_P(i^*) = 0$, which can be rearranged to get $r - i^* = \Delta e^{-\lambda\Delta i^*}$. Substituting this into the expression for $F_F(i^*)$ yields:

$$F_F(i^*) = (r - i^*) - re^{-\lambda ri^*} = \Delta e^{-\lambda\Delta i^*} - re^{-\lambda ri^*}$$

The sign of this expression is given by the sign of $f(\Delta) - f(r)$, where we define the auxiliary function $f(K) = Ke^{-\lambda Ki^*}$. The derivative, $f'(K) = e^{-\lambda Ki^*}(1 - \lambda Ki^*)$, determines if $f(K)$ is increasing or decreasing over the interval $[\Delta, r]$.

A sufficient condition for **under-investment** ($i_1 < i^*$) is $F_F(i^*) < 0$, which requires $f(\Delta) < f(r)$. Since $\Delta < r$, this holds if $f(K)$ is increasing on the interval $[\Delta, r]$. This requires $f'(K) > 0$, for which a sufficient condition is $1 - \lambda ri^* > 0$.

A sufficient condition for **over-investment** ($i_1 > i^*$) is $F_F(i^*) > 0$, which requires $f(\Delta) > f(r)$. Since $\Delta < r$, this holds if $f(K)$ is decreasing on the interval $[\Delta, r]$. This requires $f'(K) < 0$, for which a sufficient condition is $1 - \lambda\Delta i^* < 0$. ■

A.5 Proof of Proposition 4

Proof. The proof proceeds by establishing the comparative static for the wage, w_1, and then deriving the effects on B_1, q_1, i_1, and Σ_1^* as logical consequences. The wage response, $\frac{dw_1}{dx}$, is found by applying the Implicit Function Theorem to the wage FOC, $G(w_1, \mathbf{p}) \equiv d\Sigma_1/dw_1 = 0$. The sign is given by $\text{Sign}(\frac{dw_1}{dx}) = \text{Sign}(G_x)$, where $G_x \equiv \partial^2\Sigma_1/\partial w_1 \partial x$.

(i) Effect of Productivity *r*.

- **Wage:** The cross-partial with respect to r is $G_r = 2\lambda i_1 e^{-\lambda w_1}$. Since $i_1 > 0$, $G_r > 0$, which implies $\frac{dw_1}{dr} > 0$.
- **Bonus:** $\frac{dB_1}{dr} = -\beta(1-e^{-\lambda w_1})\frac{dw_1}{dr} < 0$ since $\frac{dw_1}{dr} > 0$.
- **Quit Probability:** $\frac{dq_1}{dr} = -\lambda e^{-\lambda w_1}\frac{dw_1}{dr}$. Since $\frac{dw_1}{dr} > 0$, we have $\frac{dq_1}{dr} < 0$.
- **Investment:** By the product rule, $\frac{di_1}{dr} = \frac{d}{dr}[r(1-q_1)] = (1-q_1) - r\frac{dq_1}{dr}$. Since $q_1 < 1$ and $\frac{dq_1}{dr} < 0$, both terms are positive, thus $\frac{di_1}{dr} > 0$.
- **Surplus:** By the Envelope Theorem, $\frac{d\Sigma_1^*}{dr} = \frac{\partial \Sigma_1}{\partial r} = i_1(1-e^{-\lambda w_1}) > 0$.

(ii) Effect of skill-generality ρ. The parameter ρ does not appear in the joint surplus function Σ_1 or its first-order conditions under a non-compete. Thus, all derivatives with respect to ρ are zero.

(iii) Effect of Worker Patience β.

- **Wage:** The cross-partial is $G_\beta = \frac{d}{dw_1}\left(\frac{\partial \Sigma_1}{\partial \beta}\right) = \frac{d}{dw_1}(E[U_W(w_1)]) = 1 - e^{-\lambda w_1} > 0$. Thus, $\frac{dw_1}{d\beta} > 0$.
- **Bonus:** $\frac{dB_1}{d\beta} = \frac{\partial B_1}{\partial \beta} + \frac{dB_1}{dw_1}\cdot\frac{dw_1}{d\beta} = -(w_1 + \frac{1}{\lambda}e^{-\lambda w_1}) - (1-e^{-\lambda w_1})\beta\frac{dw_1}{d\beta} < 0$.
- **Quit Probability:** $\frac{dq_1}{d\beta} = -\lambda e^{-\lambda w_1}\frac{dw_1}{d\beta} < 0$.
- **Investment:** $\frac{di_1}{d\beta} = -r\frac{dq_1}{d\beta} > 0$.
- **Surplus:** By the Envelope Theorem, $\frac{d\Sigma_1^*}{d\beta} = \frac{\partial \Sigma_1}{\partial \beta} = E[U_W(w_1)] > 0$.

(iv) Effect of Quit Rate Parameter λ. The effects depend on the value of β.

- **Wage:** The sign depends on the cross-partial $G_\lambda \equiv \partial^2\Sigma_1/\partial w_1 \partial\lambda$. Using the property of mixed partials, we find:

$$G_\lambda = \frac{d}{dw_1}\left(\frac{\partial \Sigma_1}{\partial \lambda}\right) = \frac{d}{dw_1}\left[(ri_1 - w_1)w_1 e^{-\lambda w_1} - \frac{\beta}{\lambda^2}e^{-\lambda w_1}(1+\lambda w_1)\right]$$
$$= \frac{\beta - 1}{\lambda}\left(1 - e^{-\lambda w_1} + \lambda w_1 e^{-\lambda w_1}\right) + \beta w_1 e^{-\lambda w_1}.$$

  If $\beta = 1$, the first term is zero, leaving $G_\lambda = w_1 e^{-\lambda w_1} > 0$. Thus, $\frac{dw_1}{d\lambda} > 0$. If $\beta < 1$, the first term is negative while the second is positive, making the sign of G_λ ambiguous. Thus, the sign of $\frac{dw_1}{d\lambda}$ is ambiguous.

- **Quit Probability:** The total derivative is $\frac{dq_1}{d\lambda} = -w_1 e^{-\lambda w_1} - \lambda e^{-\lambda w_1}\frac{dw_1}{d\lambda}$. If $\beta = 1$, $\frac{dw_1}{d\lambda} > 0$, so both terms are negative, implying $\frac{dq_1}{d\lambda} < 0$. If $\beta < 1$, the sign is ambiguous because the sign of $\frac{dw_1}{d\lambda}$ is ambiguous.
- **Investment:** The derivative is $\frac{di_1}{d\lambda} = -r\frac{dq_1}{d\lambda}$. If $\beta = 1$, $\frac{dq_1}{d\lambda} < 0$, implying $\frac{di_1}{d\lambda} > 0$. If $\beta < 1$, the sign is ambiguous.

- **Surplus:** By the Envelope Theorem, $\frac{d\Sigma_1^*}{d\lambda} = (ri_1 - w_1)w_1 e^{-\lambda w_1} - \frac{\beta}{\lambda^2} e^{-\lambda w_1}(1 + \lambda w_1)$. If $\beta = 1$, the first term is zero (since $w_1 = ri_1$), leaving a strictly negative result. If $\beta < 1$, the first term is positive and the second is negative, so the sign is ambiguous.

■

A.6 Existence of the Boundary Wage

Here, we formally prove the existence of the boundary wage, w_{bound}. This is the wage satisfying the fixed-point condition $w = r\,i_0(w)$, where $i_0(w)$ is the firm's optimal investment response.

LEMMA 6 (Existence and Positivity of the Boundary Wage)**.**

1. *There exists at least one non-negative boundary wage* $w_{\text{bound}} \geq 0$ *solving the equation* $w = r\,i_0(w)$.
2. *A strictly positive solution* $w_{\text{bound}} > 0$ *exists if and only if* $r\lambda\,(r - \rho) > 1$.

Proof. We define the function $\Phi(w) = r\,i_0(w)$ and seek a fixed point where $w = \Phi(w)$.

(a) Existence of a non-negative fixed point.

The firm's optimal investment $i_0(w)$ is the unique root of the first-order condition $H(i_0, w) = 0$, where

$$H(i,w) = r\big(1 - e^{-\lambda(w-\rho\,i)}\big) - (r\,i - w)\,\lambda\rho\,e^{-\lambda(w-\rho\,i)} - i.$$

The function $H(i,w)$ is twice continuously differentiable. Strict concavity of the firm's profit with respect to i is confirmed by the sign of $\partial H/\partial i$:

$$\frac{\partial H}{\partial i} = -2\lambda\rho r e^{-\lambda(w-\rho i)} - (ri - w)(\lambda\rho)^2 e^{-\lambda(w-\rho i)} - 1 < 0.$$

Given that $H(0,w) > 0$ for $w > 0$ and $H(i,w) \to -\infty$ as $i \to \infty$, the concavity of H in i guarantees a unique positive root $i_0(w)$ for any $w > 0$. The Implicit Function Theorem then ensures that $i_0(w)$ is a continuous function. Hence, $\Phi(w) = r\,i_0(w)$ is also continuous.

To prove the existence of a fixed point, we use Brouwer's Fixed Point Theorem. Let $i_{\text{bench}} \geq 0$ be the unique solution to $i = r(1 - e^{-\lambda(r-\rho)i})$. Define the set $S = [0, W_{\max}]$, where $W_{\max} = r\,i_{\text{bench}}$. This set is non-empty, compact, and convex. A rigorous analysis of the properties of $H(i,w)$ shows that for any $w \in S$, the root $i_0(w)$ satisfies $0 \leq i_0(w) \leq i_{\text{bench}}$, which ensures that Φ maps the set S into itself. Since $\Phi : S \to S$ is a continuous function on a compact, convex set, a fixed point $w_{\text{bound}} \in S$ must exist. This establishes part (a).

(b) Condition for a strictly positive fixed point.

We know $w = 0$ is always a fixed point since $i_0(0) = 0$ and thus $\Phi(0) = 0$. A strictly positive fixed point $w_{\text{bound}} > 0$ is guaranteed to exist if there is another fixed point besides zero. Since $W_{\max} = r\,i_{\text{bench}}$ is also a fixed point, a positive solution exists if and only if $W_{\max} > 0$, which requires $i_{\text{bench}} > 0$.

A positive solution $i_{\text{bench}} > 0$ to the equation $i = r(1 - e^{-\lambda(r-\rho)i})$ exists if and only if the slope of the right-hand side is greater than the slope of the left-hand side (which is 1) at the origin $i = 0$. The slope of the right-hand side at $i = 0$ is:

$$\frac{d}{di} r\big(1 - e^{-\lambda(r-\rho)\,i}\big)\bigg|_{i=0} = r\lambda\,(r - \rho).$$

Hence, $i_{\text{bench}} > 0$ if and only if $r\lambda\,(r - \rho) > 1$. This is the necessary and sufficient condition for the existence of a strictly positive boundary wage, which completes the proof of part (b). ■

A.7 Properties of the Unconstrained Optimum Without a Non-Compete When $\beta = 1$

This section proves two key properties of the unconstrained optimal wage without a non-compete, w^*_{unc}, for the case of a perfectly patient worker ($\beta = 1$).

LEMMA 7. *At any unconstrained optimal wage w^*_{unc} that maximizes the joint surplus:*

1. *The slope of the investment response function is strictly positive: $\frac{di_0}{dw_0} > 0$.*
2. *The optimal wage exceeds the worker's marginal product: $w^*_{unc} > ri_0(w^*_{unc})$.*

The proof for the first point proceeds by contradiction. The second point follows directly from the first.

Proof. The firm's choice of investment i_0 for a given wage w_0 is defined implicitly by the first-order condition of its own profit-maximization problem, which we can write as $G(i_0, w_0) = 0$:

$$G(i_0, w_0) \equiv r\left(1 - e^{-\lambda(w_0 - \rho i_0)}\right) - \lambda\rho(ri_0 - w_0)e^{-\lambda(w_0 - \rho i_0)} - i_0 = 0 \tag{13}$$

By the Implicit Function Theorem, the slope of the investment response function, $i_0(w_0)$, is:

$$\frac{di_0}{dw_0} = -\frac{\partial G/\partial w_0}{\partial G/\partial i_0} \tag{14}$$

The denominator, $\partial G/\partial i_0$, is the second derivative of the firm's profit with respect to investment. The second-order condition for a maximum requires $\partial G/\partial i_0 < 0$. Therefore, the sign of the slope is determined by the sign of the numerator:

$$\text{sign}\left(\frac{di_0}{dw_0}\right) = \text{sign}\left(\frac{\partial G}{\partial w_0}\right)$$

Calculating the numerator yields:

$$\frac{\partial G}{\partial w_0} = \lambda e^{-\lambda(w_0 - \rho i_0)}\left[r + \rho + \lambda\rho(ri_0 - w_0)\right] \tag{15}$$

Thus, the sign of the slope $\frac{di_0}{dw_0}$ is determined by the sign of the term in the brackets. We now prove by contradiction that an unconstrained optimum cannot exist where $di_0/dw_0 < 0$. An unconstrained optimum w^*_{unc} must satisfy the first-order condition for maximizing the joint surplus. For $\beta = 1$, this condition is:

$$\lambda(ri_0 - w^*_{unc}) + \rho\left(\frac{di_0}{dw_0}\right)\bigg|_{w^*_{unc}} = 0 \tag{16}$$

Let us hypothesize that an unconstrained optimum w^*_{unc} exists at a point where the slope of the investment curve is negative, i.e., $\frac{di_0}{dw_0} < 0$. Two conditions would have to be met simultaneously at this point.

We can rearrange the first-order condition:

$$\lambda(ri_0 - w^*_{unc}) = -\rho\left(\frac{di_0}{dw_0}\right)$$

Since we hypothesized $\frac{di_0}{dw_0} < 0$ and we know $\rho > 0$, the right-hand side of the equation must be strictly positive. This implies the left-hand side must also be positive. Since $\lambda > 0$, we must have:

$$ri_0 - w^*_{unc} > 0$$

The mathematical condition required for the slope $\frac{di_0}{dw_0}$ to be negative is that the following term is negative:

$$r+\rho+\lambda\rho(ri_0-w^*_{unc})<0$$

We have reached a contradiction. Therefore, our initial hypothesis is false. Any unconstrained optimum must satisfy $\frac{di_0}{dw_0}\geq 0$.

Proof that $w^*_{unc}>ri_0$ This result now follows directly from the first-order wage equation. Rearranging to solve for w^*_{unc} gives:

$$w^*_{unc}=ri_0+\frac{\rho}{\lambda}\left(\frac{di_0}{dw_0}\right) \tag{17}$$

Therefore, the unconstrained optimal wage is equal to the worker's marginal product plus a strictly positive term, which proves that $w^*_{unc}>ri_0$.

■

A.8 Proof of Proposition 5

Proof. The proof proceeds by establishing an upper bound for the equilibrium investment and showing this bound is below the social optimum. Let the social planner's marginal benefit be $\text{SMB}(i)=r-\Delta e^{-\lambda\Delta i}$, where $\Delta=r-\rho$. The social optimum i^* solves $\text{SMB}(i^*)=i^*$, as previously shown in Equation 2.

1. The Benchmark Case ($w_0=ri_0$). Consider the boundary case where the firm earns zero profits ex-post. Let the investment at this boundary be i_{bench}. Substituting $w_0=ri_0$ into the investment FOC yields $i_{\text{bench}}=r(1-e^{-\lambda\Delta i_{\text{bench}}})$. The firm's private marginal benefit in this case is $\text{PMB}_{\text{bench}}(i)=r(1-e^{-\lambda\Delta i})$. The difference between the social and private marginal benefit is $\text{SMB}(i)-\text{PMB}_{\text{bench}}(i)=\rho e^{-\lambda\Delta i}>0$. Since the social marginal benefit is strictly greater than the firm's private marginal benefit for all i, the socially optimal investment level must be strictly greater than the firm's choice, i.e., $i^*>i_{\text{bench}}$.

2. The General Case ($w_0<ri_0$). In any equilibrium where the firm earns positive profits ex-post, $w_0<ri_0$. The firm's investment reaction function is strictly increasing in the wage ($\frac{di_0}{dw_0}>0$). Therefore, any equilibrium investment $i^*_0(w^*_0)$ must be less than the investment level at the boundary benchmark: $i^*_0(w^*_0)<i_0(ri_0)=i_{\text{bench}}$. Combining these two results ($i^*_0\leq i_{\text{bench}}$ and $i_{\text{bench}}<i^*$), transitivity implies that the equilibrium investment is always strictly below the social optimum:

$$i^*_0<i^*$$

■

A.9 Proof of Proposition 6

Proof. The proof establishes the result by demonstrating that the No-NC contract achieves both a higher level of investment and more efficient separation decisions. The dominance in joint surplus follows directly from these two advantages.

1. Investment Dominance ($i^*_0>i^*_s$) An equilibrium investment level is determined where the firm's private marginal benefit of investment (PMB) equals its marginal cost (i). We show that for any given $i>0$, the PMB is strictly higher under the No-NC contract than in the spot market. The respective marginal benefits are:

$$\mathrm{PMB}_s(i) = r\underbrace{\left(1-e^{-\lambda(w_s^*-\rho i)}\right)}_{\text{Pr(Stay)}} - \underbrace{\lambda\rho(ri-w_s^*)e^{-\lambda(w_s^*-\rho i)}}_{\text{(Hold-Up)}},$$

$$\mathrm{PMB}_0^*(i) = r\underbrace{\left(1-e^{-\lambda(r-\rho)i}\right)}_{\text{Pr(Stay under No-NC)}}$$

Let the separation thresholds be $v_T^s(i) = w_s^*(i) - \rho i$ and $v_T^0(i) = (r-\rho)i$. The spot-market PMB is strictly less than its first term, since the second term is strictly positive in equilibrium ($ri > w_s^*$). Furthermore, because $w_s^*(i) < ri$, we know $v_T^s(i) < v_T^0(i)$. This allows us to construct the following strict inequality chain:

$$\mathrm{PMB}_s(i) < r\left(1-e^{-\lambda v_T^s(i)}\right) < r\left(1-e^{-\lambda v_T^0(i)}\right) = \mathrm{PMB}_0^*(i).$$

As the marginal benefit of investment is strictly greater under the No-NC contract for all $i > 0$, the equilibrium investment level must also be strictly greater, $i_0^* > i_s^*$.

2. Separation Efficiency The No-NC contract with $\beta = 1$ yields an efficient separation threshold conditional on its investment, $v_T^0 = (r-\rho)i_0^*$. In contrast, the spot market yields an inefficiently low threshold, $v_T^s < (r-\rho)i_s^*$, which causes excessive quits.

3. Joint Surplus Dominance Let the joint surplus function be $S(i, v_T)$, where $\Sigma_0^* = S(i_0^*, (r-\rho)i_0^*)$ and $\Sigma_s^* = S(i_s^*, v_T^s)$. We can now conclude that $\Sigma_0^* > \Sigma_s^*$ via the following decomposition:

$$\Sigma_0^* = S(i_0^*, (r-\rho)i_0^*) > S(i_s^*, (r-\rho)i_s^*) > S(i_s^*, v_T^s) = \Sigma_s^*.$$

The first inequality holds because $i_0^* > i_s^*$ (from Step 1) and the joint surplus function is increasing in investment in the relevant range. The second inequality holds because $(r-\rho)i_s^* > v_T^s$ (from Step 2) and the joint surplus is increasing in the separation threshold for $v_T < (r-\rho)i$. Therefore, the No-NC contract strictly dominates the spot-market equilibrium, illustrating the value of commitment. ■

A.10 Proofs of Proposition 7 and its Corollaries

Proof of Proposition 7. We prove this proposition by showing that for any given investment level i and a fixed wage w, the firm's marginal benefit of investment is strictly greater under a non-compete (NC) contract. The marginal benefit (MB) of investment without a non-compete is:

$$\mathrm{MB}_0(i;w) = \underbrace{r(1-e^{-\lambda(w-\rho i)})}_{\text{Marginal Product Effect}} - \underbrace{(ri-w)\lambda\rho e^{-\lambda(w-\rho i)}}_{\text{Hold-up Cost}}$$

With a non-compete, the hold-up cost is eliminated:

$$\mathrm{MB}_1(i;w) = r(1-e^{-\lambda w})$$

The difference in marginal benefits is:

$$\begin{aligned}
\mathrm{MB}_1(i;w) - \mathrm{MB}_0(i;w) &= r(1-e^{-\lambda w}) - \left[r(1-e^{-\lambda(w-\rho i)}) - (ri-w)\lambda\rho e^{-\lambda(w-\rho i)}\right] \\
&= r\left(e^{-\lambda(w-\rho i)} - e^{-\lambda w}\right) + (ri-w)\lambda\rho e^{-\lambda(w-\rho i)} \\
&= \underbrace{re^{-\lambda w}(e^{\lambda\rho i}-1)}_{\text{Term A}} + \underbrace{(ri-w)\lambda\rho e^{-\lambda(w-\rho i)}}_{\text{Term B}}
\end{aligned}$$

Term A is strictly positive since $\rho > 0$ and $i > 0$. Term B is non-negative for any viable wage, which requires $w \le ri$. Thus, the difference is strictly positive. As $\mathrm{MB}_1(i;w) > \mathrm{MB}_0(i;w)$ for all i, and both functions are decreasing in i, the investment level that sets the marginal benefit to its cost must be higher for the NC case. Therefore, $i_1(w) > i_0(w)$.

Part (b): Comparing Equilibrium Investments for $\beta = 1$

When the worker is perfectly patient ($\beta = 1$), the equilibrium wage is set to the worker's marginal product: $w_\delta^* = ri_\delta^*$.

No-NC Equilibrium (i_0^*): Substituting $w_0^* = ri_0^*$ into the investment FOC for the No-NC case, the hold-up cost term disappears, yielding the implicit solution for i_0^*:

$$i_0^* = r(1-e^{-\lambda(ri_0^* - \rho i_0^*)}) \quad \Longrightarrow \quad i_0^* = r(1-e^{-\lambda(r-\rho)i_0^*})$$

NC Equilibrium (i_1^*): Substituting $w_1^* = ri_1^*$ into the NC investment function yields:

$$i_1^* = r(1-e^{-\lambda ri_1^*})$$

Comparison: Consider the function $g(i;K) = r(1-e^{-\lambda Ki})$. The equilibrium investments i_0^* and i_1^* are the fixed points solving $i^* = g(i^*;K)$ for $K = r-\rho$ and $K = r$, respectively. Since $r > \rho > 0$, we have $r > r-\rho$. The function $g(i;K)$ is strictly increasing in K. Therefore, for any $i > 0$, $g(i;r) > g(i;r-\rho)$. Because the function $g(i;r)$ is strictly greater than $g(i;r-\rho)$, its intersection with the 45-degree line ($y = i$) must occur at a higher value. Thus, $i_1^* > i_0^*$. ■

Proof of Corollary 1. The proofs rely on the main proposition that equilibrium investment is higher with a non-compete, $i_1 > i_0$. For this proof, we use the benchmark condition that for $\beta = 1$, the equilibrium wage is set at the viability frontier, so $w_1 = ri_1$ and $w_0 = ri_0$.

(a) Wages: The result $w_1 > w_0$ follows directly from $i_1 > i_0$ and the wage rules.

$$w_1 = ri_1 > ri_0 = w_0.$$

(b) Quit Probabilities: The No-NC retention threshold is $T_0 = w_0 - \rho i_0 = (r-\rho)i_0$. The chain of inequalities $w_1 = ri_1 > ri_0 > (r-\rho)i_0 = T_0$ shows the NC retention threshold is strictly higher, which implies the quit probability $q_1 = e^{-\lambda w_1}$ is strictly lower than $q_0 = e^{-\lambda T_0}$.

(c) Bonus Ambiguity: The upfront bonus B depends on the worker's ex-ante expected utility. The difference in utility, $E_0 - E_1$, consists of a negative wage effect ($w_0 - w_1$) and a positive option value effect from the higher quit probability under the No-NC contract. Since these effects have opposing signs, the comparison is ambiguous. ■

Proof of Corollary 2. The upfront bonus is $B_\delta = \mu^0 - \beta E_\delta[U_W]$. To show $B_1 > B_0$, we must show the premise $w_1 < w_0$ implies $E_1[U_W] < E_0[U_W]$. The expected utilities are $E_1[U_W] = w_1 + \frac{1}{\lambda}e^{-\lambda w_1}$ and $E_0[U_W] = w_0 + \frac{1}{\lambda}e^{-\lambda(w_0-\rho i_0)}$. Let $h(w) = w + \frac{1}{\lambda}e^{-\lambda w}$. This function is strictly increasing in w. The premise $w_1 < w_0$ implies $E_1 = h(w_1) < h(w_0)$. Furthermore, since $\rho i_0 > 0$, we have $-\lambda(w_0 - \rho i_0) > -\lambda w_0$, which implies

$E_0 > h(w_0)$. Combining these gives the chain of inequalities $E_1 < h(w_0) < E_0$, proving $E_1[U_W] < E_0[U_W]$. Therefore, the bonus B_1 must be strictly higher than B_0. ■

A.11 Proofs for Proposition 8 and Corollaries

Proof. The proof first addresses the case of a perfectly patient worker ($\beta = 1$), discusses the ambiguity when $\beta \in (0,1)$, and concludes by showing NC is always preferred with $\beta = 0$

Perfectly Patient Worker ($\beta = 1$)

The analysis hinges on the derivative of the No-NC contract's surplus (Σ_0^*) with respect to skill generality (ρ). Let $q_0^*(\rho) = e^{-\lambda(r-\rho)i_0^*(\rho)}$ be the equilibrium quit probability, where $i_0^*(\rho)$ is the equilibrium investment. The total derivative of the surplus is given by the chain rule:

$$\frac{d\Sigma_0^*}{d\rho} = \frac{\partial \Sigma_0}{\partial \rho} + \frac{\partial \Sigma_0}{\partial i_0}\frac{di_0^*}{d\rho}$$

We find the closed-form expression for each component evaluated at the equilibrium.

- The direct effect of ρ on the surplus is: $\frac{\partial \Sigma_0}{\partial \rho} = i_0^* q_0^*$.
- The indirect effect of investment on surplus, using an equilibrium identity, simplifies to: $\frac{\partial \Sigma_0}{\partial i_0} = \rho q_0^*$.
- The change in equilibrium investment with respect to ρ is found via the implicit function theorem on the investment FOC, yielding: $\frac{di_0^*}{d\rho} = -\frac{r\lambda i_0^* q_0^*}{1-\lambda r(r-\rho)q_0^*}$.

Substituting these into the total derivative formula gives:

$$\begin{aligned}\frac{d\Sigma_0^*}{d\rho} &= i_0^* q_0^* + (\rho q_0^*)\left(-\frac{r\lambda i_0^* q_0^*}{1-\lambda r(r-\rho)q_0^*}\right) \\ &= i_0^* q_0^*\left(\frac{1-r\lambda(r-\rho)q_0^* - r\lambda\rho q_0^*}{1-r\lambda(r-\rho)q_0^*}\right) = \frac{i_0^* q_0^*\left(1-\lambda r^2 q_0^*\right)}{1-\lambda r(r-\rho)q_0^*}\end{aligned}$$

The denominator, $1-\lambda r(r-\rho)q_0^*$, is positive. This follows directly from the second-order condition of the firm's profit maximization. For the equilibrium investment i_0^* to be a profit maximum, the second derivative of the profit function with respect to investment must be negative, which is precisely the condition $\lambda r(r-\rho)q_0^* - 1 < 0$. Since the denominator is positive, the sign of the derivative is determined entirely by the sign of the numerator. Let's define this sign-determining function as $f(\rho) = 1-\lambda r^2 q_0^*(\rho)$.

We show that $f(\rho)$ is continuous and strictly decreasing from a positive value at $\rho = 0$ to a negative value as $\rho \to r$, which guarantees a unique root $\hat{\rho}$ where $f(\hat{\rho}) = 0$.

- At $\rho = 0$, we must show $f(0) = 1-\lambda r^2 q_0^*(0) > 0$. This is equivalent to showing $\lambda r^2 q_0^*(0) < 1$. We use the equilibrium condition for investment at $\rho = 0$, which is $i_0^* = r(1-q_0^*(0))$, and the definition of the quit probability, $q_0^*(0) = e^{-\lambda r i_0^*}$. By rearranging the investment condition and substituting, we can show the expression is equivalent to $\frac{\lambda r i_0^*}{e^{\lambda r i_0^*}-1}$. From the fundamental inequality $e^x - 1 > x$ for all $x > 0$, we know the denominator is strictly greater than the numerator, which proves the expression is less than 1. Therefore, $f(0) > 0$.
- As $\rho \to r$, $q_0^* \to 1$ and $f(\rho) \to 1-\lambda r^2 < 0$ by the assumption required for an interior solution without an NC.

- The derivative $f'(\rho) = -\lambda r^2 \frac{dq_0^*}{d\rho}$ is strictly negative because the quit probability q_0^* is an increasing function of ρ.

The Intermediate Value Theorem guarantees a unique tipping point $\hat{\rho}$. For all $\rho \in (0, \hat{\rho}]$, $\frac{d\Sigma_0^*}{d\rho} \geq 0$, which implies $\Sigma_0^*(\rho) > \Sigma_0^*(0) = \Sigma_1^*$. Therefore, the No-NC contract is strictly preferred. For the comparative statics of $\hat{\rho}$, we find its explicit formula:

$$\hat{\rho} = r - \frac{r\ln(\lambda r^2)}{\lambda r^2 - 1}$$

Taking partial derivatives shows that $\frac{\partial \hat{\rho}}{\partial r} > 0$ and $\frac{\partial \hat{\rho}}{\partial \lambda} > 0$.

Ambiguity for the General Case ($\beta < 1$)

For an arbitrary $\beta < 1$, the effect of ρ on the No-NC surplus is ambiguous. The total derivative is $\frac{d\Sigma_0^*}{d\rho} = \frac{\partial \Sigma_0}{\partial \rho} + \frac{\partial \Sigma_0}{\partial i_0}\frac{di_0^*}{d\rho}$. The direct effect, $\partial \Sigma_0/\partial \rho = i_0^* e^{-\lambda T_0^*}[\beta - \lambda(ri_0^* - w_0^*)]$, is of ambiguous sign. The indirect effect is the product of $\partial \Sigma_0/\partial i_0 = \beta \rho e^{-\lambda T_0^*} > 0$ and the investment response $di_0^*/d\rho$, which is also of ambiguous sign. With ambiguity in both the direct and indirect effects, a general result cannot be determined.

NC always preferred with $\beta = 0$

Let the firm's expected profit for a given contract (w, i) and skill-generality parameter $\rho \geq 0$ be denoted by $\Pi(w, i; \rho)$:

$$\Pi(w, i; \rho) = (ri - w)(1 - e^{-\lambda(w - \rho i)}) - \frac{1}{2}i^2$$

The profit function under an NC agreement, Π_1, is identical to this general function evaluated at $\rho = 0$. The No-NC profit, Π_0, corresponds to the case where $\rho > 0$. The firm's problem is to choose a wage w to maximize its profit, anticipating its own investment response, $i^*(w)$. The firm's value function is $V(w; \rho) = \Pi(w, i^*(w; \rho); \rho)$. The maximized equilibrium profits are $V_1^* = \max_w V(w; 0)$ and $V_0^* = \max_w V(w; \rho)$. Let w_0^* be the wage that maximizes profits in the No-NC regime, so $V_0^* = V(w_0^*; \rho)$. By the definition of a maximum, $V_1^* \geq V(w_0^*; 0)$. The proof is complete if we can show that $V(w_0^*; 0) > V_0^*$. We prove this by showing that the difference $V(w_0^*; 0) - V_0^*$ is strictly positive.

$$V(w_0^*; 0) - V_0^* = \Pi(w_0^*, i^*(w_0^*; 0); 0) - \Pi(w_0^*, i^*(w_0^*; \rho); \rho)$$

We decompose this difference by adding and subtracting the term $\Pi(w_0^*, i^*(w_0^*; \rho); 0)$:

$$\begin{aligned} V(w_0^*; 0) - V_0^* = &[\Pi(w_0^*, i^*(w_0^*; 0); 0) - \Pi(w_0^*, i^*(w_0^*; \rho); 0)] \\ &+ [\Pi(w_0^*, i^*(w_0^*; \rho); 0) - \Pi(w_0^*, i^*(w_0^*; \rho); \rho)] \end{aligned}$$

We now prove that both bracketed terms are strictly positive.

1. *The Hold-up Gain:* The second bracketed term compares the profit from the *same* contract, $(w_0^*, i^*(w_0^*; \rho))$, under two different legal regimes. Let $i_0^* = i^*(w_0^*; \rho)$.

$$\begin{aligned} \Pi(w_0^*, i_0^*; 0) - \Pi(w_0^*, i_0^*; \rho) &= (ri_0^* - w_0^*)\left[(1 - e^{-\lambda w_0^*}) - (1 - e^{-\lambda(w_0^* - \rho i_0^*)})\right] \\ &= (ri_0^* - w_0^*)e^{-\lambda w_0^*}\left[e^{\lambda \rho i_0^*} - 1\right] \end{aligned}$$

   Since $ri_0^* - w_0^* > 0$, and for $\rho > 0$ and $i_0^* > 0$ the term in brackets is positive, this "Hold-up Gain" is strictly positive.

2. *The Investment Gain:* The first bracketed term evaluates the profit under the NC regime ($\rho = 0$) at two different investment levels: the optimal one for that regime, $i_1^* = i^*(w_0^*; 0)$, versus the suboptimal

one, $i_0^* = i^*(w_0^*; \rho)$.

$$\Pi(w_0^*, i_1^*; 0) - \Pi(w_0^*, i_0^*; 0)$$

By definition, for a given wage w_0^*, the investment i_1^* is chosen to uniquely maximize the function $\Pi(w_0^*, i; 0)$ with respect to i. As established in the text, the optimal investment response is strictly higher under an NC, so $i_1^* > i_0^*$. Because i_1^* is the unique maximizer, the profit it generates must be strictly greater than the profit generated by any other investment level, including i_0^*. Therefore, this "Investment Gain" is strictly positive.

Since both components of the difference are strictly positive, their sum must be strictly positive. This proves that $V(w_0^*; 0) > V_0^*$. The full chain of inequalities is:

$$V_1^* \geq V(w_0^*; 0) > V_0^*$$

Thus, the firm's equilibrium profit is strictly higher with a Non-Compete contract.

■

Proof of Corollary 3. When a firm's investment makes a worker more productive for a competitor than for the firm itself ($\rho > r$), a standard employment contract (No-NC) becomes untenable. The firm anticipates that the worker will always be poached post-investment and thus refuses to invest, leading to zero surplus. The non-compete makes the employment relationship viable, as it allows the firm to realize the internal returns on its investment without the certainty of the worker being hired away. ■

Proof of Corollary 4. When the worker is perfectly patient ($\beta = 1$), if the non-compete (NC) contract is preferred over the no-non-compete (No-NC) contract, it is also preferred over the spot market. This result follows by transitivity. ■

A.12 Proof for Proposition 10

Proof. The proof proceeds by first deriving the conditions under which each party agrees to separate, then combining them into a unified separation rule.

Derivation of Separation Conditions For separation to occur, both the firm and the worker must find it in their interest to terminate the contract and exchange the damage payment.

The Firm's Decision. The firm prefers to separate if its payoff from receiving the damage payment exceeds its payoff from continuing the relationship. The actual wage paid if the relationship continues is $\max\{w_1, v\}$.

$$\begin{aligned} \text{Profit from Separation} &> \text{Profit from Continuing} \\ \bar{\tau} &> ri_1 - \max\{w_1, v\} \\ ri_1 - w_1 &> ri_1 - \max\{w_1, v\} \\ w_1 &< \max\{w_1, v\} \end{aligned}$$

This inequality holds if and only if $v > w_1$. Thus, the firm has an incentive to separate only when the worker's outside offer is greater than the contracted wage.

The Worker's Decision. The worker agrees to separate if their utility from moving to an industry competitor is at least as great as their alternative. The worker's value at a competitor is $v + \rho i_1$, from which they must pay the damages $\bar{\tau}$.

$$\begin{aligned}
\text{Utility from Separation to Competitor} &\geq \text{Utility from Alternative} \\
v + \rho i_1 - \bar{\tau} &\geq \max\{w_1, v\} \\
v + \rho i_1 - (ri_1 - w_1) &\geq v \quad \text{(since } v > w_1 \text{ for the firm to agree)} \\
\rho i_1 - ri_1 + w_1 &\geq 0 \\
w_1 &\geq (r - \rho) i_1
\end{aligned}$$

Thus, the worker agrees to the separation only if the contracted wage is greater than or equal to the productivity gap $(r - \rho)i_1$.

Inefficient Under-Separation The non-compete is waived and separation to the industry competitor occurs only if *both* derived conditions are met.

- If the contract is structured such that $w_1 < (r - \rho)i_1$, the worker's condition is never met. Separation is impossible.
- If the contract is structured such that $w_1 \geq (r - \rho)i_1$, separation occurs if and only if $v > w_1$.

The socially efficient rule is to separate when $v > (r - \rho)i_1$. In either case, the actual separation cutoff is at or above the efficient cutoff, leading to **under-separation** (job lock). Specifically, inefficient lack of turnover to the industry-competitor occurs when $(r - \rho)i_1 < v < w_1$.

Over-investment The firm, when designing the contract ex-ante, is drawn to the regime where $w_1 \geq (r - \rho)i_1$ because it provides perfect insurance. In this regime, the firm's second-period operating profit is *always* $ri_1 - w_1$:

- If $v \leq w_1$, the worker stays and the firm's profit is $ri_1 - w_1$.
- If $v > w_1$, the worker leaves to the industry competitor and the firm receives a damage payment of $\bar{\tau} = ri_1 - w_1$.

Anticipating this perfect insurance, the firm's problem is to choose investment i_1 to maximize its profit:

$$\max_{i_1 \geq 0} \quad \Pi(i_1) = (ri_1 - w_1) - \frac{1}{2} i_1^2$$

The first-order condition is $\frac{d\Pi}{di_1} = r - i_1 = 0$, which implies $i_1 = r$. The firm's dominant strategy is to offer a contract satisfying the insurance condition and to choose the maximum investment level, $i_1 = r$. The moral hazard arising from expectation damages results in over-investment relative to the social optimum $i^* < r$. ■

A.13 Proof for Proposition 11

Proof. The proof compares the equilibrium outcomes under the TRAP with the social planner's benchmark, where separation is efficient (conditional on investment) if $v > v_{eff} = (r - \rho)i_1$ and investment i^* is chosen to maximize expected total surplus.

1. Under-separation. The proof of under-separation first requires establishing the conditions under which separation is possible. Separation requires both the firm's and the worker's participation constraints to be satisfied. The worker agrees to the TRAP's separation terms only if their utility from doing so is greater than or equal to their utility from rejecting the offer. Formally, for $v > w_1$:

$$v + \rho i_1 - \frac{1}{2} i_1^2 \geq v \quad \Rightarrow \quad \rho i_1 \geq \frac{1}{2} i_1^2 \quad \Rightarrow \quad i_1 \leq 2\rho$$

This derivation shows that separation is only possible if the firm's investment is within the regime $i_1 \leq 2\rho$. If $i_1 > 2\rho$, the worker will always reject the separation offer.

Next, we consider the firm's incentive constraint, which defines its separation cutoff, $v_c = ri_1 - \frac{1}{2}i_1^2$. For the cases where $i_1 \leq 2\rho$, we compare this firm cutoff to the planner's efficient cutoff, $v_{eff} = (r - \rho)i_1$. The difference is:

$$v_c - v_{eff} = \left(ri_1 - \frac{1}{2} i_1^2 \right) - (r - \rho)i_1 = i_1 \left(\rho - \frac{i_1}{2} \right)$$

Since we are in the regime where $i_1 \leq 2\rho$ (which implies $\rho \geq i_1/2$), the term $(\rho - i_1/2)$ is non-negative. Thus, $v_c \geq v_{eff}$. The firm requires a higher outside offer v to release a worker than is socially optimal, leading to under-separation.

2. Inefficient Investment. The firm chooses i_1 to maximize its own profit by anticipating the outcomes of its two main strategies.

Strategy A (High Investment): Choose $i_1 > 2\rho$. This makes separation impossible. The firm maximizes $\Pi(i_1) = \mathbb{E}[ri_1 - \max\{w_1, v\}] - \frac{1}{2}i_1^2$, which yields the solution $i_1 = r$.

Strategy B (Low Investment): Choose an investment i_1 in the range $[0, 2\rho]$. In this regime, the firm's expected profit is $\Pi(i_1) = \int_{-\infty}^{v_c} (ri_1 - v)\, dF(v) + \int_{v_c}^{\infty} (\frac{1}{2}i_1^2)\, dF(v) - \frac{1}{2}i_1^2$. The first-order condition is:

$$\frac{d\Pi}{di_1} = (r - i_1) F \left(ri_1 - \frac{1}{2} i_1^2 \right)$$

For any investment level $i_1 < r$, this derivative is non-negative. Because the profit function is monotonically increasing with respect to investment in this regime, the profit is maximized at the boundary of the interval, which is precisely $i_1 = 2\rho$.

The firm's final choice is to compare profits under each strategy. Neither $i_1 = r$ nor $i_1 = 2\rho$ is chosen to satisfy the social planner's first-order condition, so investment is always inefficient. If the firm adopts Strategy A ($i_1 = r$), there is no separation in equilibrium and the result is unambiguously over-investment: $i^* < r$. If the firm adopts Strategy B ($i_1 = 2\rho$), the investment level is inefficient, but it could be higher or lower than the social optimum (i^*). ■

B Appendix Tables and Figures

Table B1: Variables Dictionary

Variable	Definition
Job Mobility	
Tenure (Yrs)	Time in years working at a job
1(Main Job Separation btwn 2017 and 2019)	Worker transitions to a new main job, becomes unemployed, or exits the labor force
1(Main Job Mobility btwn 2017 and 2019)	Worker transitions to a new main job

1(Within-Industry Job Mobility btwn 2017 and 2019)	Worker transitions to a new main job within the same industry
Wages and Wage Growth	
Log(Starting Wage)	Log of starting wage for 2017 main job
Log(Wage in 2017)	Log of wage in 2017 for main job
$Log(Wage_{2017}) - Log(Wage_{2015})$	Difference between log of wage in 2017 and log of wage in 2015 for 2017 main job
$Log(Wage_{2019}) - Log(Wage_{2017})$	Difference between log of wage in 2019 and log of wage in 2017 for 2017 main job
Demographics	
Age	Computed as the survey year minus birth year
1(Male)	The respondent is male
1(High School Degree or Higher)	The respondent has attended at least 12 years of school
1(Bachelors Degree or Higher)	The respondent has attended at least 16 years of school
ASVAB Percentile	Percentile achieved on ASVAB test
1(Black)	The respondent is Black
1(Hispanic)	The respondent is Hispanic
Wage Bargaining and Negotiation	
1(Possible to Keep Previous Job)	The respondent was able to keep previous job when offered their main job
1(Negotiate Job Offer)	The respondent negotiated their main job offer
Training	
1(Received Some Training)	Received training in a survey year
1(Received Training Run by Employer)	Received training ran by employer in a survey year
1(Received On-Site Training by Non-Employer)	Received training on-site by non-employer in a survey year
1(Employer Paid for Training)	Employer paid for training in a survey year
1(Employer Paid for Mandatory Training)	Employer paid for mandatory training in a survey year
1(Employer Paid for Voluntary Training)	Employer paid for voluntary training in a survey year
Job Tasks	
1(Use Math Skills Frequently)	Respondent claims to use math at least once a week at main job
1(Supervise Frequently)	Respondent claims to supervise more than half the time at main job
1(Problem Solve Frequently)	Respondent claims to problem solve at least once a week at main job
Other Firm Characteristics	
1(Dislike Job)	Respondent claim to 'Dislike it somewhat' or 'Dislike it very much' when asked about main job
1(Unionized Worker)	Respondent's contract was negotiated by a union or employee association for main job
Firm Size	Number of employees at respondent's main job

Table B2: Confidence in Non-Compete Status by Industry

Industry	NC Confidence			Total	Share Very Confident	Share NC Usage
	Very Confident	Somewhat Confident	Not Confident			
AGRICULTURE, FORESTRY AND FISHERIES	33	0	1	34	0.97	0.07
CONSTRUCTION	293	14	4	311	0.94	0.11
OTHER SERVICES	152	9	2	163	0.93	0.13
TRANSPORTATION AND WAREHOUSING	211	12	7	230	0.92	0.14
EDUCATIONAL, HEALTH, AND SOCIAL SERVICES	1169	93	8	1270	0.92	0.08
ACS SPECIAL CODES	191	16	1	208	0.92	0.20
UTILITIES	29	3	0	32	0.91	0.11
INFORMATION AND COMMUNICATION	86	8	0	94	0.91	0.24
FINANCE, INSURANCE, AND REAL ESTATE	312	29	3	344	0.91	0.19
ENTERTAINMENT, ACCOMODATIONS, AND FOOD SERVICES	422	38	3	463	0.91	0.07
PUBLIC ADMINISTRATION	232	21	1	254	0.91	0.08
MANUFACTURING	412	42	4	458	0.90	0.18
MINING	24	3	0	27	0.89	0.24
WHOLESALE TRADE	104	12	1	117	0.89	0.27
RETAIL TRADE	458	49	5	512	0.89	0.15
PROFESSIONAL AND RELATED SERVICES	560	64	7	631	0.89	0.28
TOTAL	4688	413	47	5148	0.91	0.15

Note:
The sample consists of NLSY97 respondents who report non-compete, non-compete confidence, and industry status in their 2017 main job. Rows are organized by share 'Very Confident' in response to the non-compete confidence question. Active duty military respondents are dropped.

Table B3: Estimated Effects of NCs using the 2019 Cross-Section

Panel 1: Wages and Wage Growth

Dependent Variables:	Log(Wage)			Wage Growth		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
1(NC)	0.305***	0.220***	0.145***	0.005	0.006	0.028
	(0.051)	(0.044)	(0.052)	(0.033)	(0.033)	(0.043)
Controls	None	Basic	Advanced	None	Basic	Advanced
Weighted Dependent Variable Mean	3.14	3.14	3.14	0.111	0.111	0.111
Fit statistics						
Observations	1,638	1,585	762	1,638	1,585	762
R^2	0.034	0.302	0.574	0.000	0.004	0.060

Panel 2: Training

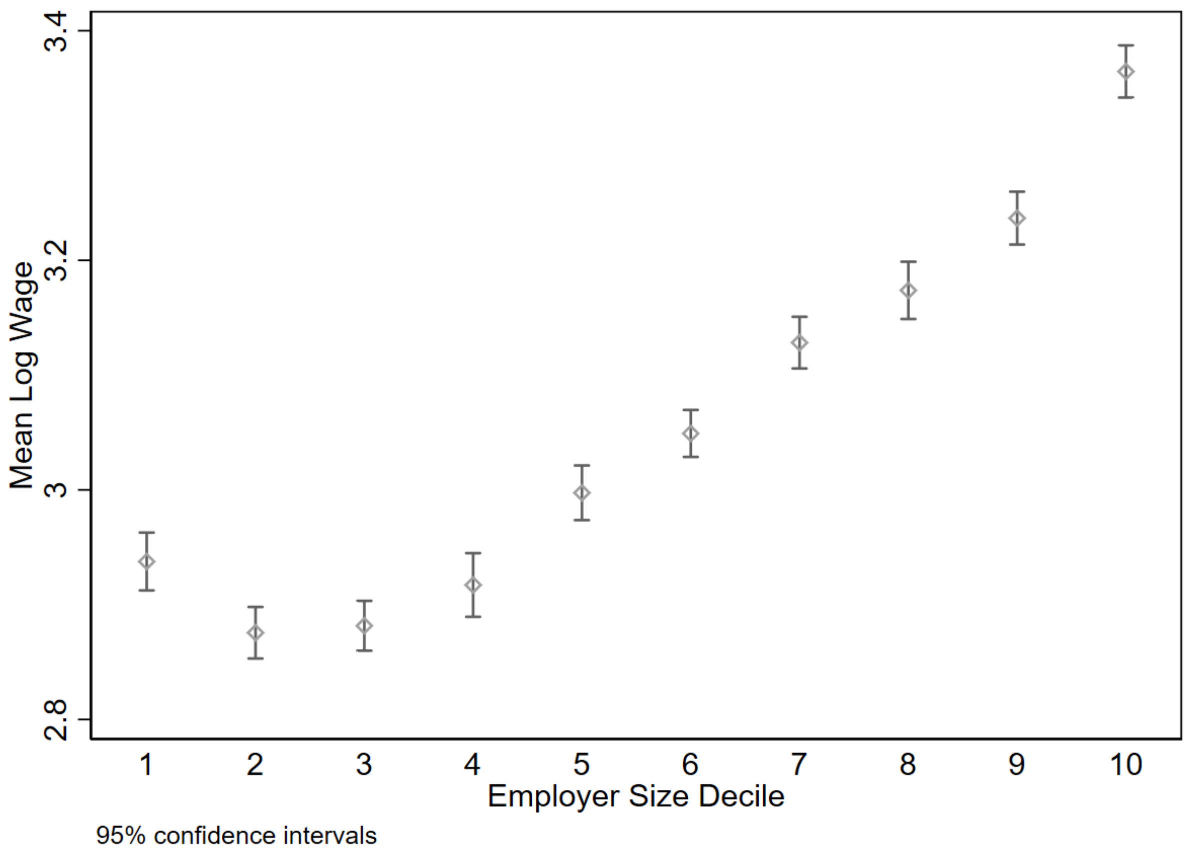
Dependent Variables:	1(Any Training)			1(Emp Paid for Training)		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
1(NC)	0.011	-0.002	-0.028	0.015	-0.002	-0.031
	(0.029)	(0.029)	(0.043)	(0.024)	(0.024)	(0.038)
Controls	None	Basic	Advanced	None	Basic	Advanced
Weighted Dependent Variable Mean	0.120	0.120	0.120	0.078	0.078	0.078
Fit statistics						
Observations	1,638	1,585	762	1,638	1,585	762
R^2	0.0001	0.007	0.108	0.0004	0.020	0.139

Panel 3: Job Mobility

Dependent Variables:	Tenure (Yrs)			1(Job Mobility Between 2019-2021)		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
1(NC)	0.256	0.237	0.116	-0.051	-0.050	-0.064
	(0.184)	(0.187)	(0.226)	(0.036)	(0.037)	(0.052)
Controls	None	Basic	Advanced	None	Basic	Advanced
Weighted Dependent Variable Mean	5.64	5.64	5.64	0.249	0.249	0.249
Fit statistics						
Observations	1,616	1,585	762	1,638	1,607	771
R^2	0.003	0.008	0.098	0.001	0.010	0.068

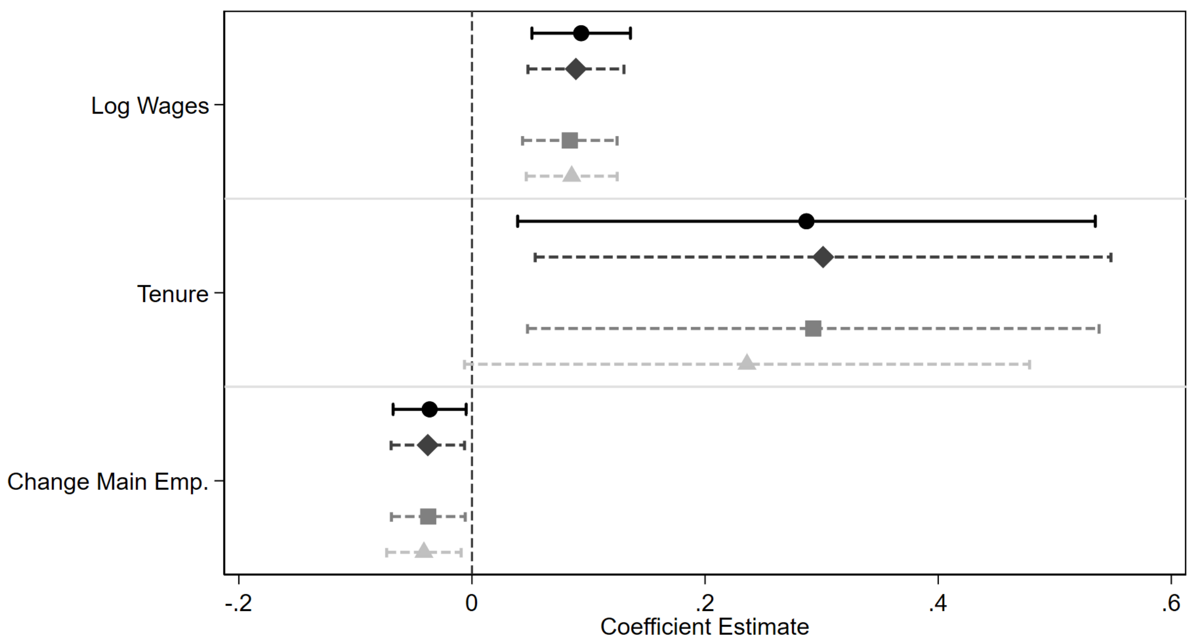
Notes: Standard errors are heteroskedasticity-robust. The sample restricts to individuals who report NC status and have real wages between 3 and 200 in 2019. Basic controls include sex, education, tenure, and potential experience. Advanced controls further add industry and occupation fixed effects, ASVAB percentile, and firm size. All regressions are weighted so as to be nationally representative. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Figure B1: Relationship Between Log Wages and Firm Size



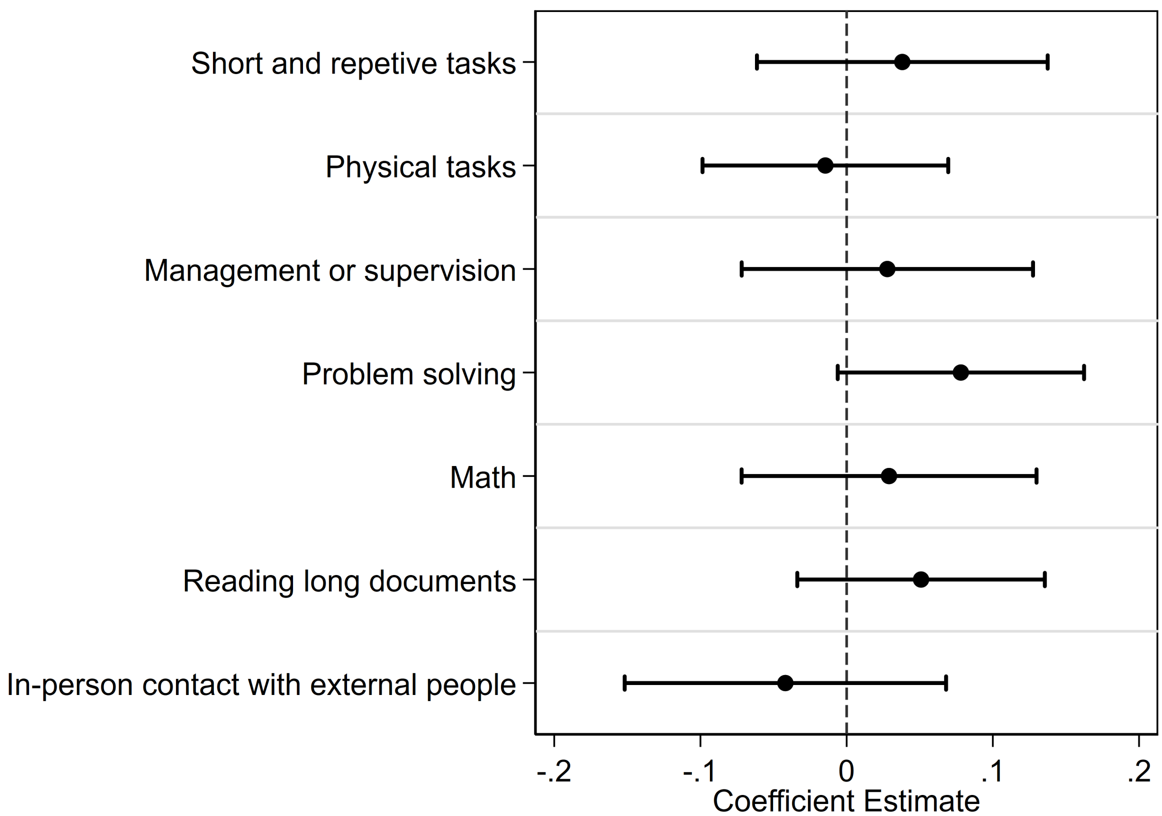
Note: Based on 2017 cross-section.

Figure B2: The Effect of Signing a Non-Compete Agreement: Robustness to Firm-Level Covariates



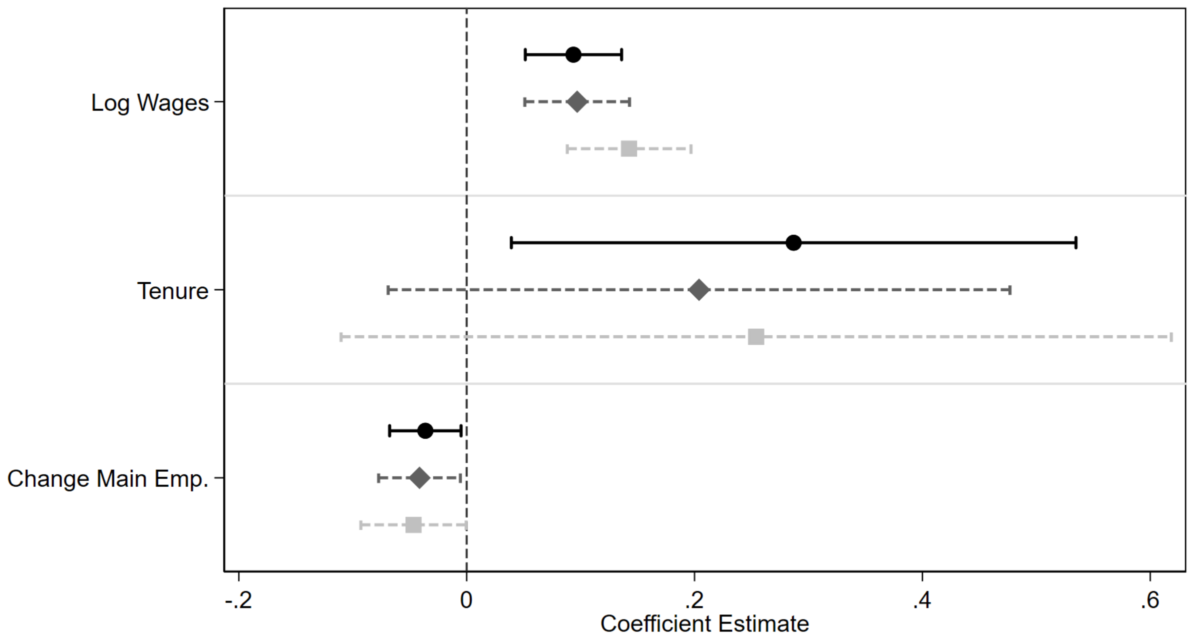
Note: Coefficient estimates are from stacked difference-in-differences estimation, aggregated over post-treatment years, over a bi-annual sample period of 2013-2021 and using cohorts $c \in \{2015, 2017, 2019, 2021\}$. The treatment group for cohort c are those who we observe first signing an NC in year c. The control group consists of workers whom we do not observe holding a NC during the event window and who also changed jobs between year c and the preceding survey year. Job mobility is defined as changing main employers between the current and preceding survey year. The black circle markers report baseline estimates from the main text. The gray diamond markers with dashed lines report estimates controlling for industry fixed effects. The square markers further add occupation fixed effects, and the triangle markers further add firm size decile fixed effects. Standard errors are clustered by worker and confidence intervals are reported at the 95% level.

Figure B3: Balance Tests for Changes in Task Content



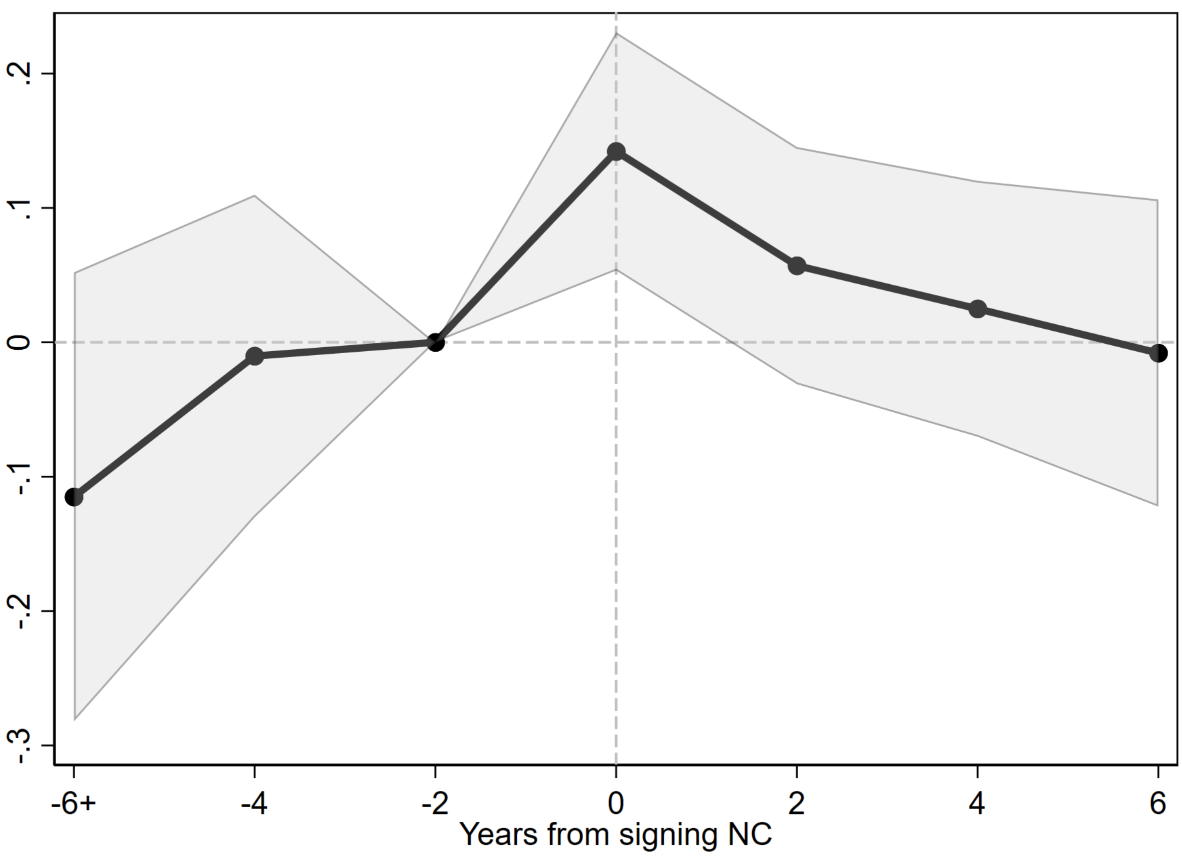
Note: Coefficients report difference-in-difference estimates on task content following equation (10). The outcome variables are indicators for whether a certain type of task is a frequent part of a workers job. Tasks content questions are available in the 2017, 2019, and 2021 survey years, and therefore we use the 2019 and 2021 cohorts for this analysis. Standard errors are clustered by worker and confidence intervals are reported at the 95% level.

Figure B4: The Effect of Signing a Non-Compete Agreement: Robustness to Different Samples



Note: Coefficient estimates are from stacked difference-in-differences estimation, aggregated over post-treatment years, over a bi-annual sample period of 2013-2021 and using cohorts $c \in \{2015, 2017, 2019, 2021\}$. The treatment group for cohort c are those who we observe first signing an NC in year c. The control group consists of workers whom we do not observe holding a NC during the event window and who also changed jobs between year c and the preceding survey year. Job mobility is defined as changing main employers between the current and preceding survey year. The black circle markers report baseline estimates from the main text. The gray diamond markers with dashed lines report coefficient estimates when we restrict attention to years 2015-2021 and cohorts $\{2017, 2019, 2021\}$. The square markers further restrict attention to years 2017-2021 and cohorts $\{2019, 2021\}$. Standard errors are clustered by worker and confidence intervals are reported at the 95% level.

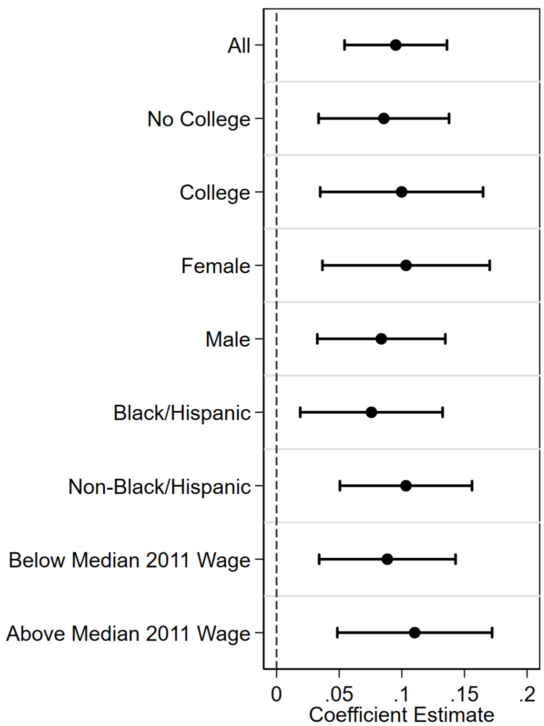
Figure B5: The Effect of Signing a Non-Compete Agreement on Wages: Later-treated as Control Group



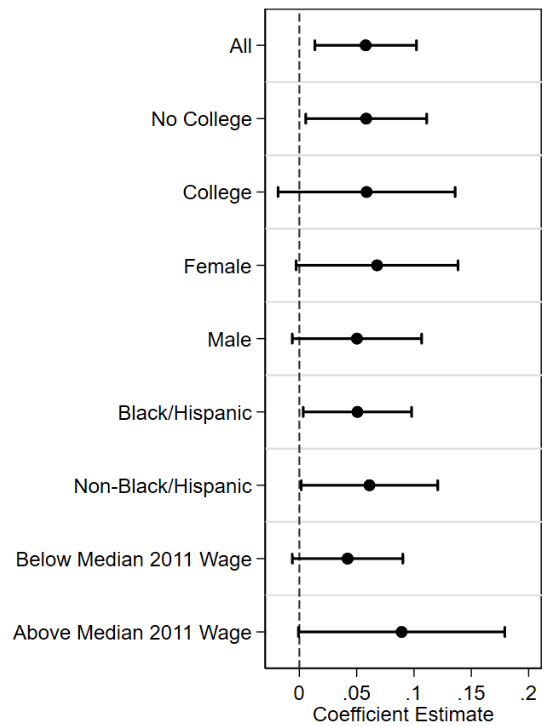
Note: Coefficient estimates are from stacked difference-in-differences estimation, aggregated over post-treatment years, over a bi-annual sample period of 2013-2021 and using cohorts $c \in \{2015, 2017, 2019, 2021\}$. The treatment group for cohort c are those who we observe first signing an NC in year c. The control group consists of workers who (a) changed jobs between year c and the preceding survey year, (b) do not hold an NC in year c, and (c) sign an NC at some $t > c$ (the later-treated job movers). Standard errors are clustered by worker and confidence intervals are reported at the 95% level.

Figure B6: Wage Effects of Signing an NC from Two-way Fixed Effects (TWFE) Models

(a) Absorbing Treatment



(b) Non-Absorbing Treatment



Note: Coefficient estimates report the impact of NCs on wages from two-way fixed effect (TWFE) models. Panel (a) reports coefficient estimates from equation (11) over a bi-annual sample period of 2013-2021. Panel (b) reports coefficient estimates from equation (12) over a bi-annual sample period of 2017-2021. Standard errors are clustered by worker and confidence intervals are reported at the 95% level.