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Guarding Expertise and Assets: Non-competition Agreements and Their Implications

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Abstract

The degree of access granted to employees to a firm's critical asset is a pivotal organizational decision. This access can boost the employees' productivity within the firm but also enables them to become competitors after leaving, leading to a holdup problem. Economic theory suggests that non-competition agreements (noncompetes) can mitigate this issue. This paper examines the optimal compensation package for an employee, considering access, wage, and noncompete agreements. I demonstrate that firms compensate lower ability agents primarily through access, coupled with the minimum wage and strictest noncompete agreements since access not only increases the employee's utility but also the firm's production. For higher ability agents, the maximum degree of access is provided, while the wage and stringency of the noncompete depends on the damage the employee causes with competing. For low damages, the firm offers a lax noncompete with lower wages. Conversely, high potential damage necessitates higher wages and a stricter noncompete. The study's findings are consistent with observed patterns in CEO contracts.

1 Introduction

Successful firms possess unique critical assets that enable them to generate economic surplus [Rajan and Zingales, 2001]. These assets can range from innovative technology and robust customer relationships to novel tools. A crucial organizational decision involves determining how much access to the critical asset to provide to employees, as they may replicate the technology, walk away with customers, or steal crucial information. On the one hand, the greater the degree of access provided to employees, the more they understand the operations of the firm, and the more effectively they can contribute to the firm's profitability. On the other hand, extensive knowledge about the firm's critical asset enables employees to become fierce rivals, either by setting up their own startups or by joining existing competitor firms. To mitigate this risk, firms frequently employ non-competition clauses (commonly referred to as noncompetes).[1] Economic theory suggests that noncompetes can help alleviate the hold-up problem [Williamson, 1979] by aligning the incentives of employers and employees [Lipsitz, 2017]. Noncompete agreements have become increasingly common in recent years, with almost 20% of US employees currently subject to such clauses [Prescott et al., 2021]. The use of noncompetes is also prevalent in Europe, with similar ratios reported [Boeri et al., 2022].

This paper explores the optimal compensation package for employees, encompassing access, wage, and noncompete, and how these elements vary with the employee's level of ability. The higher an employee's ability, the greater the compensation they demand. The main friction of the model is the inability of employees to commit ex post to staying with the firm, potentially leaving after gaining access to the firm's critical asset and causing damage. Despite the risk of ex post departure, the firm prioritizes access as compensation mechanism because it boosts both the employee's utility and the firm's productivity. Hence, the first key result of this paper is that access to the firm's assets is non-decreasing with respect to the employee's ability. That is, if it is optimal to employ an agent with a certain degree of access, it is also always optimal to employ an agent who has greater ability, with at least as high degree of access as the lower ability colleague.

Another key finding of the paper specifically concerns high ability agents, who demand the highest compensation. These employees are provided the maximum access to the firm's assets, while the remaining compensation depends on the extent of damage the employee may cause through competition. With low damages, the firm offers a lax noncompete with smaller wages. Conversely, when the potential damage is high, the firm compensates with increased wages paired with a more stringent noncompete. This compensation dynamic, especially evident in CEO contracts as documented by [Kini et al., 2021], is coherently explained by the model, offering a theoretical framework for these observed real-world practices

In the theoretical model, the firm offers an employment contract to an agent, he, whose primary attribute is his level of ability. The contract specifies both the stringency of the noncompete agreement and the degree of access to the firm's critical asset. The employee's

[1] "[N]on-compete agreements are contracts between workers and firms that delay employees' ability to work for competing firms." ([US-Treasury, 2016], p.3)

productivity is dependent on both their level of ability and the degree of access provided to the assets. Greater access leads to increased production potential for the employee. However, the employee cannot commit to staying with the firm, and a competing firm may offer them a job before production takes place. The offer from the competitor is proportional to the degree of access the employee has at the firm, as providing access transfers knowledge and information to the employee, which may benefit the competitor. The firm incurs damages if the employee leaves and takes their knowledge with him. To mitigate this risk, the firm may include a noncompete covenant of varying stringency in the contract, which restricts the employee's potential outside opportunities and reduces the firm's damages if the employee leaves.

One key aspect of the model is that even with the most stringent noncompete clause, the employee still has some outside opportunities available due to legal limits on the stringency of the restriction. For instance, the degree of noncompete could represent the minimum distance that a competitor must be located from the firm in order to make an employment offer to the employee, with a natural boundary such as a state or country. Joining a competitor in a different state causes less harm to the firm, but still impacts its future profitability. The cost of implementing the noncompete clause is implicit in the model, as it reduces the expected payoff of the employee, thereby compelling the firm to increase compensation to meet the participation constraint of the employee's ability level.

In the first part of the paper, I focus on how the optimal contract in terms of noncompete and access is influenced by the prior ability of the agent. Ability is ex ante observable, contractible, and constant over time. The connection between ability and noncompete is particularly interesting as this relationship is non-monotonic shown by the data from the National Longitudinal Survey of Youth. The data suggests that when ability is measured solely by education level, the highest ability agents do not necessarily have a higher likelihood of a noncompete in their contracts than others in the labor market.[2] In alignment with above evidence, recent studies have highlighted the prevalence of noncompete agreements among low and mid-wage workers as well, including physicians [Lavetti et al., 2019], cleaning staff,[3] and sandwich makers.[4]

An important assumption of the model is that a low ability employee learns from high ability colleagues. As a result, competitors value these low ability workers more highly than their initial ability level would suggest. This knowledge transfer significantly increases the damage to the incumbent firm if such an employee departs.

The primary findings of the baseline model can be summarized as follows: the firm estab-

[2]The non-monotonic relationship is illustrated in Figure 9 in Appendix A.
[3]Financial Times, 10-16-2018
[4]New York Times, 04-14-2014

lishes a minimum threshold of ability, below which the agent's potential harm upon joining a competitor outweighs their expected production, rendering them unemployable. Above this threshold, agents are hired and subjected to the strictest noncompete agreements in their contracts. This is because although their contribution to the firm's profits is minimal, their departure can have an outsized impact due to their propensity for learning. These agents are given only enough access to the firm to incentivize them to accept the employment offer.

In the intermediate range, the agents have abilities closer to, but still below, the average ability of the population. To ensure their participation, the firm offers them a high degree of access and a less stringent noncompete clause. These agents make a significant contribution to the firm's profit, so the firm is willing to offer them employment despite the potential threat of their leaving.

For high-ability agents who have abilities higher than the average of the firm, the firm provides them with a high degree of access to maximize their output potential. However, since these agents pose a greater threat of leaving and causing significant damage, the same stringency of the noncompete is offered as in the previous range. In the subsequent part of the paper, I examine how the relative size of the firm's damage and the employee's outside option affects the optimal contract. Additionally, The model is also expanded to include an initial period where the firm can offer an unconditional monetary transfer (wage) to the employee, which does not incentivize staying with the firm. The findings reveal that when firm damage is smaller, the firm opts for a contract with a lower wage and a less stringent noncompete, reducing the firm's costs. Conversely, in the scenario with larger firm damage, a higher wage coupled with a more stringent noncompete becomes preferable to minimize losses from the employee's potential departure. This result is consistent with the empirical evidence of Kini et al. (2019), where they approach the problem from the employees' side and find that CEO's are less likely to have a noncompete in their contract if it greatly decreases their outside option. This situation occurs when the CEO is not qualified to work in another industry.

I also examine the size of the firm with respect to the maximum stringency of the noncompete permitted. This analysis reveals that more stringent noncompetes enable the firm to hire lower ability agents while mitigating potential damages from their departure. Since the maximum ability of agents remains constant across both regimes, the firm's size is larger when noncompete agreements are more stringent. Additionally, my findings indicate a non-monotonic relationship between firm size and the ratio of the employee's ex post outside option to firm damage. Specifically, when this ratio is small, the employee derives minimal benefit from the outside option, but the cost to the firm is significant. In such scenarios, the firm sets a higher minimum ability requirement, which results in a smaller overall firm size. Conversely, when the employee's gain from external access is substantial, the firm faces higher compensation demands in the bargaining process, necessitating a higher minimum ability threshold. Consequently, the firm size exhibits an inverted U-shaped function in relation to the employee gain to firm damage ratio.

In addition, this paper investigates the optimal regulation of noncompete stringency and examines whether setting an upper limit enhances welfare. Such an upper bound could be linked to the duration or geographic scope of the covenant's enforceability. The regulator's objective is to maximize ex post welfare, factoring in the firm's production, the employee's outside options, and the potential damage to the firm. I find that imposing an upper bound on noncompete stringency is unnecessary when the employee's gain from joining a competitor is smaller than the potential damage to the firm. A more stringent noncompete acts as an incentive for the firm, encouraging it to provide greater access to employees. This is due to the fact that a more stringent noncompete reduces the firm's expected damage if an employee departs, making it profitable to hire agents with lower abilities. Consequently, this approach leads to an increase in the firm's size, as the risk associated with providing access is mitigated. However, as the employee's outside option increasing outweighing the firm damage imposing an upper bound on the stringency of the noncompete may improve welfare. The regulator must trade off the benefit of strict regulation in terms of facilitating access provision and the cost that great outside options are reduced.

My work closely relates to two streams of literature: one focusing on access and the other on noncompete agreements. The concept of access, as introduced by Rajan and Zingales [1998], is defined as 'the ability to use or work with the critical resource' of a firm, be it physical or an idea (p.388). They compare this with property rights theory and optimal asset ownership [Grossman and Hart, 1986]. In their related work, Rajan and Zingales [2001] explore a tradeoff similar to the one in my study, where granting access enhances a manager's productivity but also poses the risk of them becoming a competitor upon departure. Their focus is on organizational aspects such as the hierarchy and size of the firm. My paper contributes an additional perspective by considering the intangible aspects of access that employees retain upon leaving and introducing noncompete agreements as a direct instrument against competition.

In the work of Garicano and Rayo [2017], the accessible asset is exclusively knowledge. Their dynamic model describes a scenario where an expert imparts divisible knowledge to a novice, which can also be utilized externally. The novice's incentive to stay hinges solely on the additional knowledge they can gain. My paper, in contrast, concentrates on the one-period optimal access in the context of employee ability heterogeneity.

Comparing access to training and investment is important in understanding its nature. The literature on specific and generic human capital investment, initiated by Becker [1962], considers who should bear the costs of investment. In a frictionless world, firms are willing to subsidize specific investment only, since generic investment increases the employee's outside option, making them a tougher bargaining opponent. In the model presented in this paper, access increases an employee's productivity both inside and outside the firm. What distinguishes access from either type of investment is that the firm's future profitability is damaged if the employee moves on to a competitor. The reason is that the employee's knowledge of the critical resource of the firm, when used outside the firm, makes them a more formidable competitor. For instance, they may develop a competing product that reduces the firm's market share and lowers profit. Another difference from training is that giving access has no direct cost. Access assumes that the critical resource is already created, and the employee is not required to put any effort into its creation. In section 3.4, I provide an analytical comparison between investment and access.

Economic theory suggests that noncompete agreements can help alleviate the hold-up problem [Williamson, 1979] by aligning the incentives of the employer and employee [Lipsitz, 2017]. Following the above idea, Garmaise [2009], Ghosh and Shankar [2017] study setups when the firm and worker co-invest into the worker's human capital, taking non-compete exogenous and endogenous respectively. Both papers reach the conclusion that with noncompete in the employment contract firms increase the investment, while when the non-compete is forgone the employee tends to invest more. Wickelgren [2018] uses a dynamic setup to show that firms invest more when the employee is bounded by a stronger noncompete. Noncompete is a continuous variable indicating the time length the covenant applies. In our paper, we have similar dynamics in the sense that the firm gives a higher degree of access if the noncompete is stronger. However, access is given to an already created resource which only has an indirect cost that the employee may use it outside the firm and causes damages. Lipsitz [2017] sets up a similar model to mine in that the employee may spin-off before production and compete. However, the paper emphasizes the difference in effort with centralized and decentralized decision making in the sense of centralized decisions are closer to first best.

While much of the existing literature has focused on how noncompete agreements affect high-skilled employees [April and Matthew, 2008, Krakel and Sliwka, 2009], recent studies have highlighted the prevalence of such agreements among low and mid-wage workers as well, including physicians [Lavetti et al., 2019], cleaning staff,[5] and sandwich makers.[6] Lipsitz and Johnson [2018] also underscore the impact of noncompete agreements on low-wage workers in their theoretical model, where the employer is required to pay a minimum wage but values the employee's contribution less than that wage. As the employee gains experience and their contribution becomes more valuable, noncompete agreements allow the employer to increase wages less steeply, as outside job opportunities are less attractive due to the restrictions imposed by the agreement.

A growing body of empirical literature has examined the relationship between noncompete clauses and various labor market outcomes such as wages, training, and mobility. While standard economic theory predicts that workers subject to noncompetes should receive higher compensation, the empirical evidence is less clear. For instance, Marx et al. [2009] show that the enforcement of noncompetes attenuates mobility, while Starr et al. [2019] find that increasing enforceability of noncompete agreements increases the training provided by firms. Additionally, Balasubramanian et al. [2020] demonstrate that both wages and mobility increased after a ban on noncompetes in Hawaii. The majority of the empirical research focuses on whether the wage increases [Johnson et al., 2021, Lipsitz and Starr, 2021, Starr et al., 2019] or decreases [Kini et al., 2021, Lavetti et al., 2019, Guimaraes et al., 2021] when the enforceability of noncompetes decreases.

As for the institutional background, the enforceability of noncompete agreements varies across different regions, with variations in regulations and legal frameworks. For instance, noncompete agreements are enforceable in major European countries [Weberndörfer et al., 2017]. However, there is increasing tension around noncompete agreements [Kalse, 2019], with debates surrounding their impact on employee mobility and innovation. In the United States, regulations regarding noncompete agreements vary from state to state, with recent scrutiny from the Federal Trade Commission, which has proposed a complete ban on noncompete agreements in early 2023 [Federal Trade Commission, 2023].

The remaining of the paper is organized as follows. Section 2 outlines the model setup, while Section 3 presents the optimal contract. Sections 4-7 focus on extensions, such as wage and asymmetric employee gain/firm damage. Finally, Section 8 concludes the paper.

[5] Financial Times, 09-06-2022
[6] The New York Times, 01-16-2021

2 Model

2.1 Setup

A risk neutral firm offers a contract to a risk neutral agent (he) in period 0. The agent has an observable type $A \in [1, A^{\max}]$, that is his ability. [7] Ability is exogenous, ex ante observable, and contractible and it can pertain to his educational degree or specific knowledge certification. The contract specifies the degree of access, $\Theta \in [0, 1]$, the employee has to the assets of the firm, and a non-competition agreement (noncompete), λ. The employee has maximum access to the firm's assets if $\Theta = 1$. The firm's asset may be innovative technology, a client list, or the know-how of a new tool. The noncompete the firm chooses falls in the range of $\lambda \in [0, \bar{\lambda}]$, where the legal upper bound on the stringency of the noncompete is denoted by $\bar{\lambda} \leq 1$.

In period 1, the matching between the firm and the employee is revealed. This match could involve factors such as the employee's fit with the firm's culture, compatibility with other employees, or other personal characteristics. The probability of the employee being a good match with the firm is an exogenous factor, denoted by p. In the case of a good match, the employee's productivity with the firm is given by the equation:

$$F(A, \Theta) = A\Theta \tag{1}$$

.

That is, the production increases both in the access provided to the employee and in his ability. Conversely, the employee is a bad match with the firm with $(1-p)$ probability, in which case he is unproductive with the firm.

At $t = 1.5$, the employee receives an offer from a competing firm. The main friction of the model is the employee's inability to commit to staying with the initial firm, meaning he may choose to accept the competitor's offer. If he decides to join the competitor, he ceases to produce for the original firm. Conversely, if the employee remains, production takes place, and the resulting payoffs are determined through Nash bargaining between the firm and the employee. Figure 1 show the game tree, while the timeline is depicted in Figure 2. Further details on the bargaining, including the outside options are provided below.

[7] $A^{\max}$ is a finite constant.

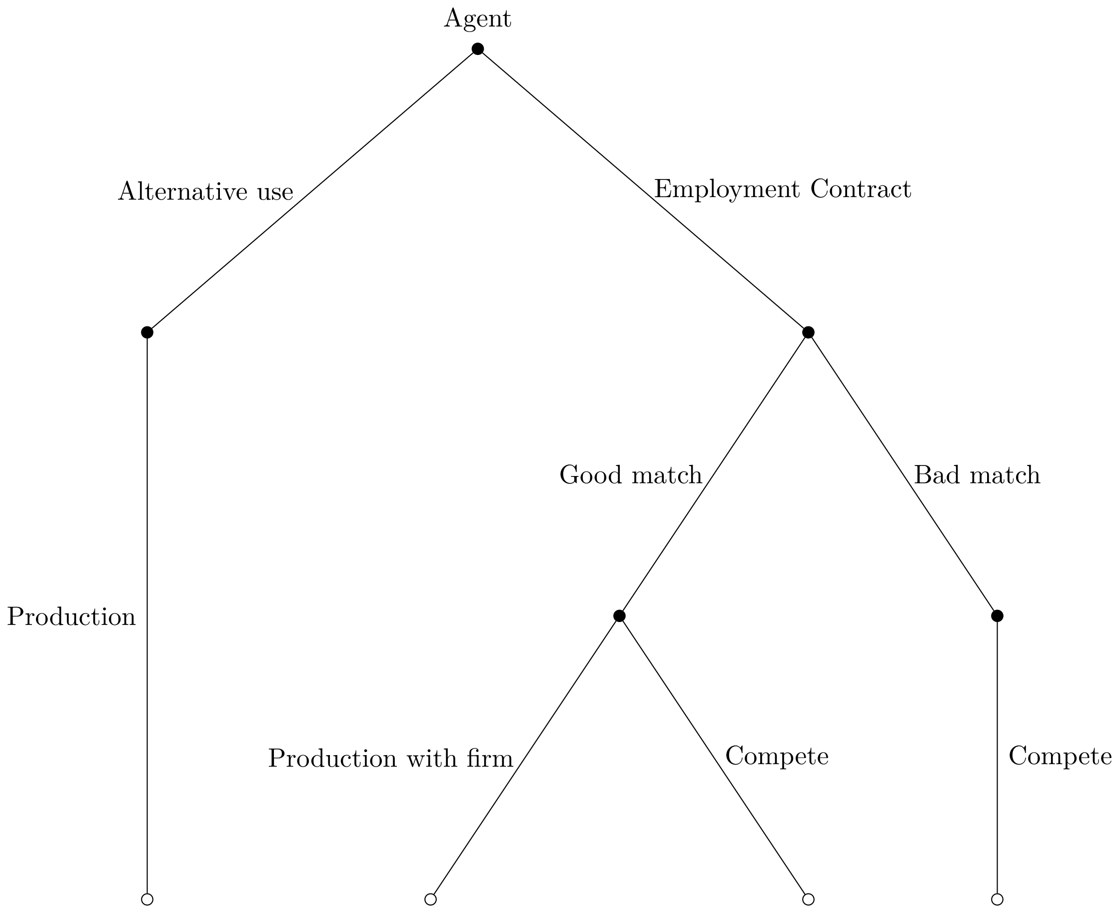

Figure 1: Game tree

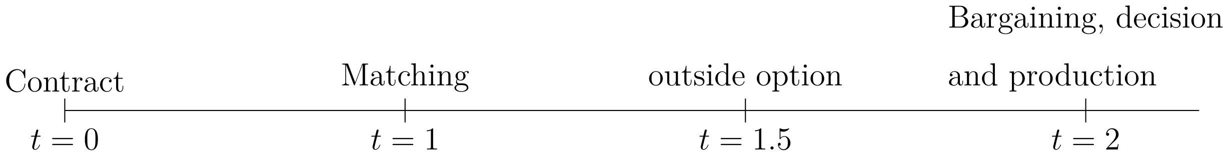

Figure 2: Time line

2.2 Outside option

A crucial part of the model is the competitor's employment offer to the employee. This offer is determined by several variables that are broken down in this section. My definition of outside option also involves the possibility that the employee starts his own business.

2.2.1 High and low ability agents

I distinguish between high and low ability agents.

$$\begin{cases} A \geq \bar{A} & \text{(high ability)} \\ A < \bar{A} & \text{(low ability)} \end{cases} \tag{2}$$

Employees are classified based on their abilities relative to the average ability in the population, denoted as $\bar{A} in [1, A^{max}]$. Those with abilities below $\bar{A}$ are considered low ability, while those above it are categorized as high ability. During their tenure, low ability employees learn from their high ability counterparts, acquiring skills and enhancing their networks. Notably, the firm is unable to regulate this transfer of knowledge or access to human capital among employees. As a result, at $t = 1.5$, low ability employees may receive job offers that surpass what their initial abilities would warrant. However, this learning and skill acquisition by low ability employees does not contribute to an increase in the firm's overall productivity, as these skills, connections, and networks were pre-existing assets within the firm.

The assumption of low ability employees learning from high ability colleagues stems from a large macroeconomic literature in which economic growth is fueled by learning from others. Most recently, Jarosch et al. [2021] empirically finds that more higher paid coworkers substantially increase future wage growth. In particular, they suggest that there is significant learning from coworkers that earn more. Nix [2020] also establishes learning spillovers. Coworkers learn general skills from each other that increase future productivity. Theoretically, the most similar modeling assumption to this paper is made by Jovanovic [2014] that a young (less talented) agent's skill depends on his innate talent and on the average skill of the old. Models by Lucas [2009], Lucas and Moll [2014], Perla and Tonetti [2014], and Buera and Oberfield [2020] build growth theories based on random meetings and skill transfer among agents.

In contrast to their low ability colleagues, high ability employees do not learn during the employment and thus their offer is a function of their initial ability. This is similar to Jovanovic and Rob [1989] in that high ability agents already know the skills of the low ability ones thus there is no more learning. Furthermore, I assume that the firm does not influence the average ability strategically. When the firm hires an individual, they consider the specific agent's ability and do not factor in the marginal change in the average ability.

Cost of access

The employer incurs the following indirect costs of providing access. Firstly, access increases the outside option of the employee. As a result, he will be able to obtain a higher payoff from the Nash-bargaining. I refer to this effect as employee gain. I denote the exact functional form the ex-post outside option of the employee, $g(A, \Theta)$.

$$g(A,\Theta) = \begin{cases} \alpha(1-\lambda)A\Theta^2, & \text{for } A \geq \bar{A} \qquad \text{(high ability)} \\ \alpha(1-\lambda)\bar{A}\Theta^2, & \text{for } A < \bar{A} \qquad \text{(low ability)} \end{cases} \tag{3}$$

Consider the first line of equation (23) for a high ability employee. The gain is an increasing function of access, Θ. In particular, the quadratic function yields that any level of access leads to at least as high production inside the firm as the employee's outside option may be, since $\Theta^2 \leq \Theta$ for $\Theta \leq 1$. However, the difference becomes smaller as the level of access approaches 1. The intuition is that the more the firm reveals its critical asset, the easier it is to reproduce it outside. The probability that the agent receives and outside offer is $(1-\lambda)$ meaning a more stringent noncompete decreases the probability that the employee receives an outside option. Furthermore, the gain is increasing linearly in ability, similar to production.

For low ability agents, the outside option is the function of the ability at $t = 1.5$, which is $\bar{A}$ due to the learning.[8]

The second source of cost of giving access to the employee is that the firm's future profitability is decreased due to the effect that the employee transfers his knowledge on the critical asset to the competitor. We refer to this effect as the firm's damage. Similar arguments to the employee gain leads to similar functional form, $d(A, \Theta)$.

[8] Making it both function of initial ability and the average would not change the results qualitatively but would hinder analytical solutions

$$d(A,\Theta) = \begin{cases} (1-\lambda)A\Theta^2, & \text{for } A \geq \bar{A} \qquad \text{(high ability)} \\ (1-\lambda)\bar{A}\Theta^2, & \text{for } A < \bar{A} \qquad \text{(low ability)} \end{cases} \tag{4}$$

2.3 Payoffs

I normalize the firm's outside option/participation constraint to 0 which is also the output without the employee. Following the literature on organizational economics and contract theory, among others ([Grossman and Hart, 1986],[Rajan and Zingales, 1998], [Rajan and Zingales, 2001] or [Hart, 2009] most recently [Bar-Isaac and Levy, 2022], the output is distributed according to the standard Nash bargaining solution, when the employee is a good match, with the employee having β bargaining power. If the employee is a bad match, both players receive their outside option that depends on the contract (λ, Θ).

2.3.1 Low ability

In the case $A < \bar{A}$, the employee learns from high ability colleagues inside the firm, making the gain and damage proportional to $\bar{A}$. Denote with subscript L the functional forms for low ability employees

$$U_L = p(\beta(A\Theta - g(\bar{A},\Theta) + d(\bar{A},\Theta)) + g(\bar{A},\Theta)) + (1-p)g(\bar{A},\Theta) \tag{5}$$

The employee is a good match with the firm with probability p, in which case there is $A\Theta$ production inside the firm. The employee's outside option is increasing by $(1-\lambda)\bar{A}\Theta^2$, while the firm's decreasing by the same amount, thus the surplus becomes $p(A\Theta - (1-\lambda)\bar{A}\Theta^2 + (1-\lambda)\bar{A}\Theta^2) = pA\Theta$. The second part of the expression is when the employee is a bad match with the firm. In this case, the employee leaves to the competitor.
The profit of the firm is

$$\pi_L = p((1-\beta)(A\Theta - g(\bar{A},\Theta) + d(\bar{A},\Theta)) - d(\bar{A},\Theta) - (1-p)(1-\lambda)d(\bar{A},\Theta) \tag{6}$$

The profit can be broken down similarly to the employee's utility.

2.3.2 High ability

In this case the employee's outside option is a function of his own ability, denote the functional forms with subscript H.

$$U_H = p(\beta(A\Theta - g(A,\Theta) + d(A,\Theta)) + g(A,\Theta) + (1-p)g(A,\Theta) \tag{7}$$

The interpretation is similar to before.

The profit of the firm

$$\pi(A > \bar{A}) = p((1-\beta)(A\Theta - g(A,\Theta) + d(A,\Theta)) - d(A,\Theta) - (1-p)d(A,\Theta) \tag{8}$$

2.4 Participation constraint

The agent has an ability dependent outside opportunity, which we call the alternative use of his ability at time 0. It serves as his participation constraint and takes the following form.

$$U^{\text{PC}} = \gamma A \tag{PC}$$

with $\gamma < 1$ as the marginal return of ability at the beginning of the game.

2.5 Actions and outcomes

At $t = 0$ the employee chooses between the alternative use of his ability and employment by the firm. If the agent is employed by the firm, with $(1-p)$ probability he is a bad match and is leaving to the competitor. With probability p there is a good match and production may take place with bargaining over the output.
Figure 1 summarizes the actions the employee can take.
Equilibrium is defined as the contract under which the firm's profit is maximized.

2.6 Parameter assuption

$$\gamma > p\beta, \tag{9}$$

introduces the friction that the employee has a higher return on its own than with the firm. In other words, higher ability agents are more expensive for the firm.

3 Optimal contract - Baseline model

The firm proposes a contract that specifies the stringency of the noncompete and the degree of access (λ, Θ) to be provided to the employee. The firm maximizes its profit given the participation constraint of the employee, the maximum degree of access the firm has, and the legal constraint on the stringency of noncompete $(\bar{\lambda})$. The firm participation constraint is checked afterward. As the profit and utility functions vary for employees with high and low ability, the problem is solved separately for each case.

3.1 Low ability

First consider the case when the employee has low ability. Equation (6) and (5) can be rewritten in the following way

$$\max_{\Theta,\lambda} \pi_L(\Theta, \lambda) = p(1-\beta)(A\Theta) - (1-\lambda)\bar{A}\Theta^2 \tag{10}$$

s.t

$$p\beta(A\Theta) + (1-\lambda)\bar{A}\Theta^2 \geq \gamma A \tag{PC}$$

$$\Theta \leq 1 \tag{Access}$$

$$\lambda \leq \bar{\lambda} \tag{Noncompete}$$

Define $\tilde{A}$ as $\frac{\bar{A}(1-\bar{\lambda})}{\gamma - p\beta}$, representing the ability level at which the agent's participation contract becomes binding under the contract that grants maximum access $(\Theta = 1)$ and the most stringent noncompete condition $(\lambda = \bar{\lambda})$.

Lemma 1A *The lowest ability employees, $A < \tilde{A}$, inside the firm are compensated by access, while they are subject to the most stringent noncompete.*

The formal proofs are in the appendix.

Denote the optimal access and noncompete with $\Theta^*(A) = \Theta^* = \Theta_{pc}$ and $\lambda^*(A) = \lambda^*$ to simplify the notation. For the lowest ability employees, the firm offers the most stringest noncompete paired with a degree of access such that the agent accepts the contract and becomes the employee of the firm. Since the firm gives a take it or leave it offer, the utility the employee receives equals the participation constraint. That is

$$U_L = p\beta A\Theta_{pc} + (1-\bar{\lambda})\bar{A}(\Theta_{pc})^2 = A\gamma \tag{11}$$

Equation (11) highlights that the firm can use two instruments to satisfy the agent's participation constraint: increasing access and decreasing the stringency of the noncompete. Consider a contract characterized by λ', Θ'pc, where $\lambda' < \bar{\lambda}$, and $\Theta' < \Theta\text{pc}(\bar{A})$. In this scenario, Θ'_{pc} is set such that the employee's participation constraint is binding. Increasing λ and Θ such that the participation constraint remains to be binding leads to higher expected production. While the employee's utility remains unchanged, the expected production - and consequently, the firm's profit - increases. To sum up the argument, increasing access yields to higher expected production, while decreasing the stringency of the noncompete only increases the employee's expected utility at the expense of lowering the firm's profit. Formally, this can be represented as

$$\frac{\frac{\partial \pi_L}{\partial \Theta}}{\frac{\partial U_L}{\partial \Theta}} = \frac{p(1-\beta)A - 2(1-\lambda)\bar{A}\Theta}{p\beta A + 2(1-\lambda)\bar{A}\Theta} > \frac{\frac{\partial \pi_L}{\partial \lambda}}{\frac{\partial U}{\partial \lambda_L}} = -1. \tag{12}$$

Expression (12) shows that marginally increasing access is dominant to marginally decreasing noncompete.

Differentiating both sides of equation (11) with respect to A gives

$$p\beta\Theta_{\text{pc}} + A\frac{\partial \Theta_{\text{pc}}}{\partial A} + 2(1-\bar{\lambda})\bar{A}\Theta_{\text{pc}}\frac{\partial \Theta_{\text{pc}}}{\partial A} = \gamma. \tag{13}$$

The rationale for focusing on the parameter range $\gamma > p\beta$ in the context of γ is elucidated in equation (13). Under this parameter assumption, equation (13) can only be met if $\frac{\partial \Theta_{\text{pc}}}{\partial A} > 0$. This translates to higher ability employees being more expensive for the firm to compensate. As ability increases, the firm also has to modify the contract due to the increased participation constraint. Conversely, if $\gamma < p\beta$, the firm could decrease the compensation of the employee as his ability rises, which would be unrealistic.

Define $\tilde{A}$ as the ability level at which the optimal contract involves granting maximum access, denoted as $\Theta = 1$, coupled with the most stringent noncompete, indicated by $\lambda = \bar{\lambda}$

Lemma 1B

For all low ability employees with $A > \tilde{A}$, the firm provides the maximum access and compen-

sation is adjusted through a less stringent noncompete agreement.

Since the firm cannot further increase access beyond $\Theta = 1$, the only means to satisfy the participation constraint for the employees $A > \tilde{A}$ is by reducing the stringency of the noncompete. I define the optimal noncompete as $\lambda^* = \lambda_{\text{pc}}$, where the stringency of the noncompete is adjusted to meet the participation constraint at the highest degree of access. Consequently, any contract defined by $\lambda' < \lambda_{\text{pc}}(\bar{A})$ and $\Theta < 1$ is suboptimal, as established previously.

The utility function for the employee is represented by:

$$U_L = p\beta A + (1 - \lambda_{\text{pc}}(\bar{L}))\bar{A}\Theta_{\text{pc}}^2 = A\gamma \tag{14}$$

Upon differentiating this equation with respect to ability, A, we obtain:

$$p\beta - \bar{A}\frac{\partial \lambda}{\partial A} = \gamma \tag{15}$$

Given that $\gamma > p\beta$, equation (15) can only hold true if $\frac{\partial \lambda}{\partial A} < 0$. This implies that as an employee's ability increases, their demand for higher compensation leads the firm to lessen the stringency of the noncompete agreement as a strategy to attract them to the firm.

Lemma 1C *The firm sets a minimum ability threshold for employment, denoted as A_{min}. Agents with abilities below this threshold are not employed.*

The firm's requirement of a minimum ability level, A_{min}, for employment arises from the need to satisfy its own participation constraint. Utilizing the optimal values of access and noncompete, Θ^* and λ^*, the firm's participation constraint can be expresse as

$$\pi(\Theta^*, \lambda^*) = p(1 - \beta)(A\Theta^*) - (1 - \lambda^*)\bar{A}\Theta^{*2} \geq 0 \tag{16}$$

This can be rewritten as:

$$p(1 - \beta)(A\Theta^*) \geq (1 - \lambda^*)\bar{A}\Theta^{*2} \tag{17}$$

As established in Proposition 1A, the firm offers the contract $\Theta^* = \Theta_{\text{pc}}$ and $\lambda^* = \bar{\lambda}$ for the lowest ability agents. Hence, (18) becomes

$$p(1 - \beta)A\Theta_{\text{pc}} \geq (1 - \bar{\lambda})\bar{A}\Theta_{\text{pc}}^2 \tag{18}$$

The firm must ensure that the expected production not only satisfies the employee's participation constraint but also generates sufficient profit for the firm since the employee might leave the firm causing damages. Increasing the degree of access, Θ, has dual effects: it raises expected production ($pA\Theta$) but also amplifies potential damages $[(1-\bar{\lambda})\bar{A}\Theta^2]$. The damages, being a function of $\bar{A} > A$, highlight the risks associated with providing high degree of access to lower ability agents. The damage is a function of $\bar{A} > A$, that directly points out the costly feature of giving too much access for the lowest ability agents. Their contribution is limited to their ability, yet they are capable of inflicting greater harm. Furthermore, the degree of access required to achieve a certain level of output decreases as ability increases, implying that agents with the lowest ability require higher degrees of access.

The next proposition formally summarizes the optimal contract for low ability agents.

Proposition 1.
1.) The firm requires a minimum ability for employment. That is, below a threshold A_{min} agents are not employed.
2.) The lowest ability agents employed by the firm are compansated via access. That is, $\exists\tilde{A}$ such that for $A_{min} < A < \tilde{A}$, the optimal contract includes the most stringent noncompete ,$\bar{\lambda}$, and degree of access $\Theta_{pc}(A)$) that is high enough to meet the agent's participation constraint.
3.) Agents with ability $\tilde{A} < A \leq \bar{A}$, are provided the maximum access,$\Theta = 1$.To meet their participation constraint, the firm reduces the strictness of the noncompete as their ability increases.

The formal proof is in the Appendix.

3.2 High ability

For high ability agents the outside option and damage function changes to $d(\lambda, \Theta, A) = g(\lambda, \Theta, A) = (1-\lambda)A\Theta^2$, which are functions of the agent's own ability that is higher than average. Hence, the profit and utility functions change accordingly to

$$\max_{\Theta,\lambda} \pi_H(\Theta, \lambda) = p(1-\beta)(A\Theta) - (1-\lambda)A\Theta^2 \tag{19}$$

$$p\beta(A\Theta) + (1-\lambda)A\Theta^2 \geq \gamma A \tag{PChigh}$$

Proposition 2. *The optimal contract for high ability agents involves the maximum degree of access and a constant, not type dependent, noncompete.*

The maximum level of access makes the employee productive inside, while the noncompete agreement restricts their ability to use this access outside the firm. The employee's participation constraint is linearly increasing with ability, and so are the production and the outside option. In equilibrium, these increments are equal when the firm offers the optimal stringency of non-compete. Therefore, even though employees with higher abilities require more compensation, the stringency of noncompete is constant for them.

The following figure graphically represents the optimal contracts and resulting profits, production utility, and the offer from the competitor for both low and high ability employees. The varying colors in the figure correspond to the different segments of the ability space, as outlined in Propositions 1 and 2.[9]

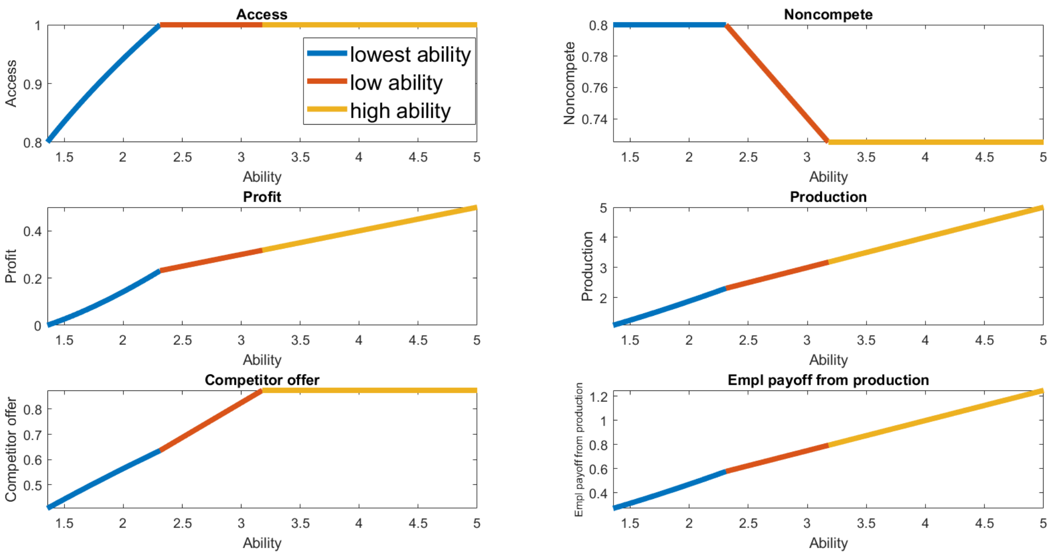

Figure 3: Optimal contract

Figure 3 summarizes the optimal contract in the first row, and the outcomes in the second and third row. The figures show that employees are compensated first via access, and if the maximum degree of access is provided via a decreasingly stringent noncompete.

From Proposition 1 and 2, the following corollary directly arises.

Corollary 1. *Access is weakly increasing in ability.*

Both the productivity and the outside option depend on the level of access provided to an agent. If it is profitable for the firm to employ one agent, it is also profitable to employ

[9]Details on the parameter values used in this illustration can be found in the appendix.

another agent with slightly higher ability, as the latter will produce more within the firm. This conclusion follows mathematically from the linear nature of the production function and the quadratic relationship of the outside option with access.

3.3 Firm size

This section examines the size of the firm in terms of the agents' ability levels. Firstly, it is important to note that the firm always hires the highest ability agents in the population, as they contribute the most to the firm's profits due to the linear relationship between ability and profits.[10]

Next, consider the lowest ability agent employed by the firm, denoted as A_{min}. At this lower bound, both the agent's and the firm's participation constraints are binding. Therefore, A_{min} can be determined by setting the firm's profit to zero under the contract specified by $(\bar{\lambda}, \Theta_{\text{pc}})$

$$p(1-\beta)(A_{\text{min}}\Theta_{\text{pc}}) - (1-\bar{\lambda})\left(\frac{A_{\text{max}} + A_{\text{min}}}{2}\right)\Theta_{\text{pc}}^2 = 0 \tag{20}$$

Above yields

$$A_{\text{min}} = \frac{A_{\text{max}}(1-\bar{\lambda})\gamma}{2p^2(1-\beta) - (1-\bar{\lambda})\gamma} \tag{21}$$

The next lemma summarizes the comparative statics of the lower threshold of ability.

Lemma 1.

Parameters	A_{min}
$A_{\text{max}} \uparrow$	$\uparrow$
$\beta \downarrow$	$\uparrow$
$\gamma \uparrow$	$\uparrow$
$p \uparrow$	$\downarrow$
$\bar{\lambda} \uparrow$	$\downarrow$

Table 1: Comparative statics of threshold of ability

Proof. By inspection of (21). □

As the maximum ability level of agents in the population rises, the average ability inside the firm also increases. This leads to lower ability agents having more to learn and becoming more costly to retain. As a result, the firm requires a higher minimum level of ability. Similarly, an

[10] As emphasized in the model description, the firm does not take into account that hiring high ability agents increases the average ability and thus has an implicit cost as well.

increase in agents' bargaining power, β, enables them to expropriate more from production, prompting the firm to increase the threshold on ability. If the marginal value of ability in the participation constraint, γ, increases, agents demand higher compensation (higher access). However, as access increases, the damage to the firm also increases. Therefore, the firm ensures that only agents with sufficiently high ability can join by raising the lower bound. Conversely, if the probability of a match, p, is higher, the threshold is lowered as agents produce with a higher likelihood.

Lastly, if regulation permits a more stringent noncompete, then the firm lowers the threshold on ability. The following graphs visually depict this effect, contrasting the scenarios of an unenforceable noncompete agreement ($\bar{\lambda} = 0$) with an enforceable one ($\bar{\lambda} = 0.2$).

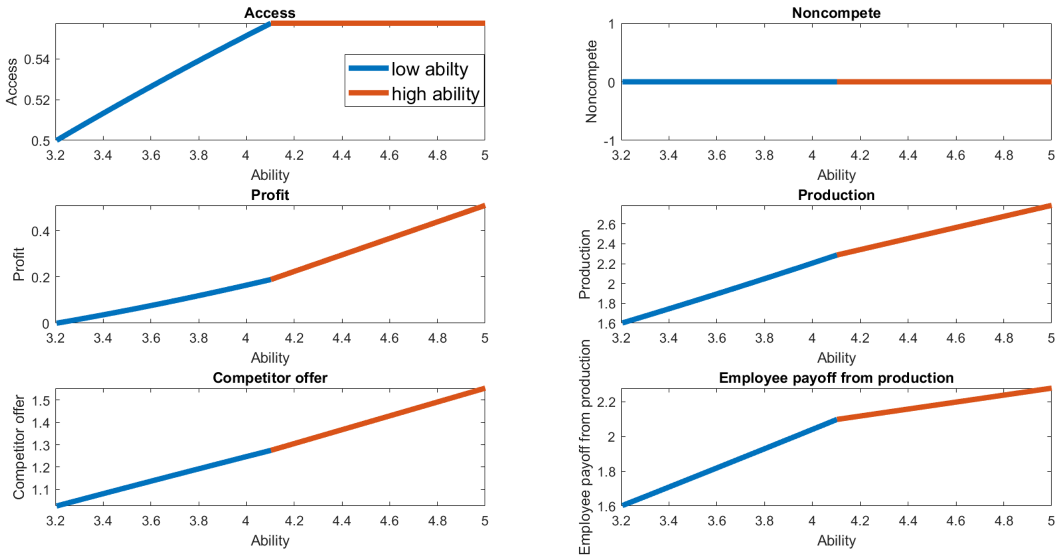

Figure 4: Unenforceable noncompete $\bar{\lambda} = 0$

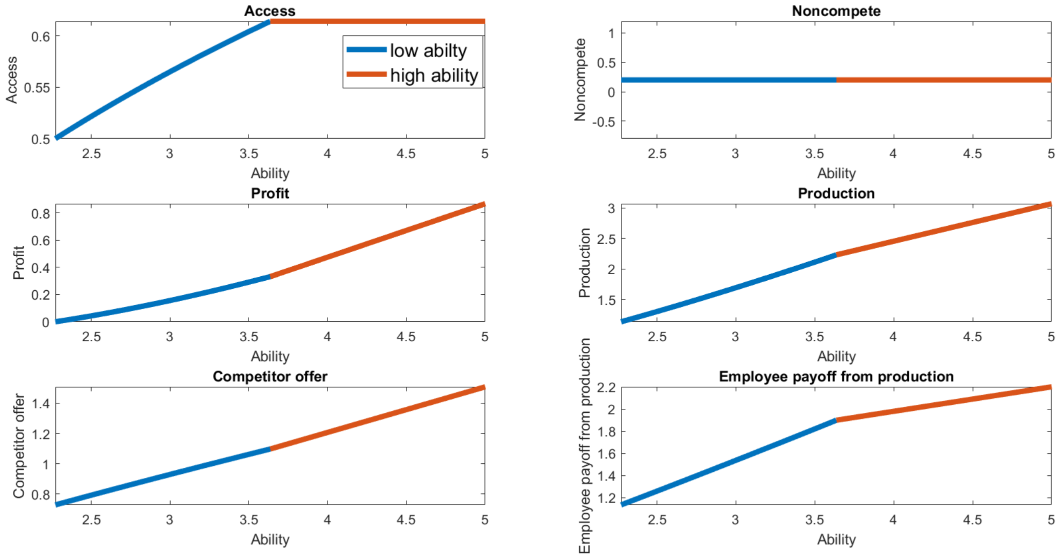

Figure 5: Enforceable noncompete $\bar{\lambda} = 0.2$

Figures 4 and 5 show the difference in the contract and outcomes when noncompete is unenforceable and enforceable respectively. A more stringent noncompete facilitates access provision resulting in higher production, profit, and employee payoff from production. However, it decreases the offer the employee receives from the competitor.

Consider a scenario where the lowest ability agent is offered a contract under a regime with $\bar{\lambda} = 0$. If the regime shifts to a more stringent noncompete ($\bar{\lambda} = 0.2$), the same contract would not be acceptable to the agent. This change occurs because a more stringent noncompete diminishes the agent's gains from the outside option, failing to meet their participation constraint with the initial contract terms. However, the firm can still realize a profit under the stricter noncompete regime by increasing the degree of access provided to the agent. Increased access enables the agent to be more productive within the firm, thereby enhancing the firm's profit. Consequently, the firm adjusts by offering greater access to satisfy the agent's participation constraint.

Although the agent's total compensation remains unchanged across both regimes, its composition shifts. Under the regime with the more stringent noncompete, the agent is provided a higher degree of access, resulting in increased earnings from internal production. Conversely, in the regime with a laxer noncompete, the agent benefits more from external opportunities, enhancing their compensation from these outside options. These variations in the outside option and employee compensation from production are depicted in the last row of the graphs.

As demonstrated in Table 1, the implementation of more stringent noncompete clauses reduces the minimum ability threshold set by the firm. Given the reduced probability of employees engaging in competition externally, the firm is inclined to provide a greater degree of access to agents with lower abilities. Consequently, this leads to a lower average ability level within the firm.

3.4 Investment

This section draws a comparison between the firm's approach to providing access to its resources and the alternative strategy of directly investing in an employee's human capital. While providing access involves allowing the employee to utilize the firm's existing assets, direct investment focuses on enabling the employee to develop new, intangible assets within the firm. This distinction leads to two key differences: an agent's departure inflicts less damage when investment in human capital is involved, but the initial investment is more expensive. I represent this investment by i, and its associated cost by $c(i)$. For the sake of comparison, I assume that the investment cannot exceed 1, and the cost of investment is borne by the firm. The problem of the firm with low ability agents is as follows:

$$\max_{i,\lambda} \pi(i,\lambda) = p(1-\beta)(Ai - (1-\lambda)\bar{A}i^2) + (1-p)0 - c(i) \tag{22}$$

s.t

$$p(1-\beta)(Ai - (1-\lambda)\bar{A}i^2) + (1-p)(1-\lambda)\bar{A}i^2 \geq \gamma A \tag{PC}$$

$$i \leq 1 \tag{Access}$$

$$\lambda \leq \bar{\lambda} \tag{Noncompete}$$

Lemma 2. *Given a certain level of ability, the optimal level of investment is higher than the optimal level of access, i.e.,* $i^*(A) > \Theta^*(A)$.[11]

Proof follows in the text.

The firm has less incentive to retain an employee who can cause no ex post damage. The employee anticipates that he can demand less compensation ex post and thus requires more ex ante compensation, i.e., more investment. Thus, given a certain level of ability, the optimal level of investment is higher than the optimal level of access, i.e., $i^*(A) > \Theta^*(A)$.

Regarding the size of the firm, the comparison between the ex ante cost of investment, denoted as $c(i)$, and the ex post cost of providing access is crucial. The ex post cost of access, labeled as $q(\Theta, A)$, encompasses not only the firm's damages but also the additional

[11] $i^*(A) = \frac{-p\beta A + \sqrt{p^2\beta^2 A^2 - 4(1-\bar{\lambda})\bar{A}(1-p\beta)\gamma A}}{(1-\lambda)\bar{A}1(1-p\beta)}$

compensation owed due to the employee's strengthened bargaining position. Assuming that the ex ante cost of investment for a given level of ability, A, is not higher than the ex post cost for the same degree of access, expressed as $c(i, A) \leq q(\Theta, A) \quad \forall A \quad \text{and} \quad i = \Theta$, the optimal contract includes a higher investment than it would access. Consequently, the minimum level of ability required by the firm (A_{min}) is lower with investment than with access, resulting in a larger firm size with investment. Only if the ex ante cost is significantly higher than the ex post cost, $c(A, i^*) > q(A, \Theta^*)$, can the minimum level of ability be lower under access, resulting in a larger firm size.

4 Different outside option than firm damage

In this section, I introduce a scalar α that denotes the ratio between the employee's outside option compared to the firm's damage.

$$g(A, \Theta) = \begin{cases} \alpha(1-\lambda)A\Theta^2, & \text{for } A \geq \bar{A} \qquad \text{(high ability)} \\ \alpha(1-\lambda)\bar{A}\Theta^2, & \text{for } A < \bar{A} \qquad \text{(low ability)} \end{cases} \tag{23}$$

Note that $d(A, \Theta) = \frac{g(A,\Theta)}{\alpha}$. Thus if $\alpha > 1$, the employee's outside option is higher than the firm's damage, if $\alpha < 1$ the firm's damage is larger. The parameter α represents the ratio of the employee's outside option to the firm damage if the employee leaves the firm for the competitor. If α is high, the employee can capitalize on access to the firm's crucial asset at the competitor, such as transferring clients or learning about crucial technological inventions, to a greater extent than the firm is damaged from it. Moreover, empirically, α also reflects labor market conditions: high α implies numerous competitors where the employee could capitalize on his knowledge.

This extension builds on the empirical result in Kini et al. [2019]. They find that CEOs are less likely to have noncompete in their contract when they expect greater personal costs and more likely when firms expect to suffer greater harm if departing CEOs work with competitors. In the language of my model, CEOs have a less stringent noncompete if their gain from leaving is larger than the firm's damage, that is, if the parameter α is high. Note that $\alpha \neq 0$ also changes the bargaining outcome as the outside option of the employee changes.

The utility of a low ability employee becomes

$$U_L(\lambda, \Theta, A, \alpha) = p\beta(A\Theta + (1-\alpha)(1-\lambda)\bar{A}\Theta^2) + \alpha(1-\lambda)\bar{A}\Theta^2 \tag{24}$$

and the utility of a high ability agent is

$$U_H(\lambda, \Theta, A, \alpha) = p\beta(A\Theta + (1-\alpha)(1-\lambda)A\Theta^2) + \alpha(1-\lambda)A\Theta^2 \tag{25}$$

Similarly, the profit of the firm takes the form

$$\pi_L(\lambda, \Theta, A, \alpha) = p(1-\beta)(A\Theta + (1-\alpha)(1-\lambda)\bar{A}\Theta^2) - (1-\lambda)\bar{A}\Theta^2 \tag{26}$$

and

$$\pi_H(\lambda, \Theta, A, \alpha) = p(1-\beta)(A\Theta + (1-\alpha)(1-\lambda)A\Theta^2) - (1-\lambda)A\Theta^2 \tag{27}$$

accordingly.

If $\alpha > 1$, the employee's gain from capitalizing on the access the firm provided at the competitor is larger than the damage caused to the firm. On the other hand, if $\alpha < 1$, the damage to the firm is larger than the gain of the employee. The optimal contract in this case is similar to the one with $\alpha = 1$. Therefore, I move on to the question of the minimum ability required by the firm, which also determines the firm size. As before, the minimum ability required by the firm can be calculated by making both the agent's and the firm's participation constraint binding.

$$U_L(\lambda, \Theta, A, \alpha) = p\beta(A\Theta + (1-\alpha)(1-\bar{\lambda})\bar{A}\Theta^2) + \alpha(1-\bar{\lambda})\bar{A}\Theta^2 = 0 \tag{28}$$

$$\pi_L(\lambda, \Theta, A, \alpha) = p(1-\beta)(A\Theta + (1-\alpha)(1-\bar{\lambda})\bar{A}\Theta^2) - (1-\bar{\lambda})\bar{A}\Theta^2 = 0 \tag{29}$$

Proposition 3. *For high enough p and $(1-\beta)$, the minimum ability required by the firm, $A_{min,\alpha}$, has the following characteristics*
$\frac{\partial A_{min,\alpha}}{\partial \alpha} < 0$ *for* $\alpha < \alpha^T$
$\frac{\partial A_{min,\alpha}}{\partial \alpha} > 0$ *for* $\alpha > \alpha^T$,
with α^T being an endogenous threshold.

The proposition states that the minimum ability inside the firm is a non-monotonic function of α due to two reasons. Firstly, if α is very low, the cost of access for the firm is high, but the agent benefits less from it, hence the firm has to compensate the agent more. As a result, an increase in α on this domain ($\alpha < \alpha^T$) leads to a decrease in the minimum ability and hence a larger firm size. On the other hand, if α is high, agents demand high compensation in the bargaining, making it expensive for the firm to keep them. Therefore, if $\alpha > \alpha^T$, a further increase in α increases the firm's costs and results in a smaller firm size. It is important to note that having a high enough p and $(1-\beta)$ ensures the firm makes a positive profit with some contracts.

Lemma 3. *The size of the firm increases if the regulator allows more stringent noncompetes.*

The size of the firm increases as the legally allowed stringency of the noncompete increases, similar to previous results. If the employee has a lower probability of competing, the firm can provide more access to low ability employee's and hence the firm becomes larger. The result follows from implicitly differentiating the profit function with respect to $\bar{\lambda}$.

4.1 Wage

This subsection augments the model by introducing a first period in which the employee receives an unconditional wage.[12] The minimum wage, $\underline{w}$, is constrained to be less than γ, $\underline{w} < \gamma$, to ensure that the minimum wage is below the participation constraint for all abilities. It is important to note that the wage has no incentive effects; meaning, increasing the wage of an employee does not lead to a higher level of production. Instead, the wage influences the employee's decision to accept the contract by affecting their participation constraint. The central question emerging from this model extension concerns identifying the most suitable compensation instrument for employees of varying ability levels and for different values of α, which represents the ratio between the employee's outside option and the damage they could potentially cause to the firm. For simplicity, it is assumed that there is no discounting

The utility of low and high ability employees, respectively, are

$$U_L(\lambda, \Theta, w, A, \alpha) = p\beta(A\Theta + (1-\alpha)(1-\lambda)\bar{A}\Theta^2) + \alpha(1-\lambda)\bar{A}\Theta^2 + w \tag{30}$$

$$U_H(\lambda, \Theta, w, A, \alpha) = p\beta(A\Theta + (1-\alpha)(1-\lambda)A\Theta^2) + \alpha(1-\lambda)A\Theta^2 + w \tag{31}$$

Similarly, the profit of the firm respectively, is

$$\pi_L(\lambda, \Theta, w, A, \alpha) = p(1-\beta)(A\Theta + (1-\alpha)(1-\lambda)\bar{A}\Theta^2) - (1-\lambda)\bar{A}\Theta^2 - w \tag{32}$$

$$\pi_H(\lambda, \Theta, w, A, \alpha) = p(1-\beta)(A\Theta + (1-\alpha)(1-\lambda)A\Theta^2) - (1-\lambda)A\Theta^2 - w \tag{33}$$

[12]This unconditional compensation could also have different interpretations, such as a bonus or even a non-pecuniary benefit.

4.1.1 Optimal contract

First, I solve the firm's problem for the low ability agents. The firm's problem becomes

$$
\begin{aligned}
\max_{\Theta,\lambda,w} L(\Theta,\lambda,w) = {} & p(1-\beta)(A\Theta+(1-\alpha)(1-\lambda)\bar{A}\Theta^2)-(1-\lambda)\bar{A}\Theta^2-w \\
& -\mu_1(-p\beta(A\Theta+(1-\alpha)(1-\lambda)\bar{A}\Theta^2)-\alpha(1-\lambda)\bar{A}\Theta^2-w+\gamma A) \\
& -\mu_2(\Theta-1) \\
& -\mu_3(\lambda-\bar{\lambda}) \\
& -\mu_4(\underline{w}-w)
\end{aligned} \tag{34}
$$

The interesting question arising from the setup is how the firm prefers to compensate the employee as there are three different instruments under its disposal. Denote the contract in the form (Θ,λ,w).

Lemma 4.

1.) The firm requires a minimum ability for employment, $A_{min}(\underline{w},\alpha)$

2.) The lowest ability agents employed by the firm are compensated via access.

Lemma 4 provides the familiar results. Increasing access to meet the employee participation constraint has the secondary effect of higher production. Thus it is a better instrument to remunerate employees than wage or noncompete.

In mathematical terms

$$
\frac{\frac{\partial\pi(\Theta,w,\lambda)}{\partial w}}{\frac{\partial U(\Theta,w,\lambda)}{\partial w}} = -1 < \frac{\frac{\partial\pi(\Theta,w,\lambda)}{\partial\Theta}}{\frac{\partial U(\Theta,w,\lambda)}{\partial\Theta}} = -\frac{p(1-\beta)(A+2(1-\alpha)(1-\bar{\lambda})\Theta-2(1-\bar{\lambda})\bar{A}\Theta}{p\beta(A+2(1-\alpha)(1-\bar{\lambda})\Theta+2\alpha(1-\bar{\lambda})\bar{A}\Theta} \tag{35}
$$

For the remainder of the domain of ability, I divide the optimal contract into two subcases, whether $\alpha<1$ or $\alpha>1$.

Proposition 4. *Agents with $A>\tilde{A}(w,\alpha)$*

are compensated via wage if $\alpha<1$

are compensated via a less stringent noncompete if $\alpha>1$

For $A>\tilde{A}(w,\alpha)$, the firm provides the maximum access 1. Thus, one of the remaining instruments needs to be adjusted, either decreasing the stringency of the noncompete or increasing the wage. Expressing this mathematically yields:

$$\frac{\frac{\partial \pi(\Theta,w,\lambda)}{\partial \lambda}}{\frac{\partial U(\Theta,w,\lambda)}{\partial \lambda}} = \frac{p(1-\beta)(-(1-\alpha)\bar{A}) + \bar{A}}{p\beta(-(1-\alpha)\bar{A}) - \alpha\bar{A}} \tag{36}$$

If $\alpha < 1$,

$$\frac{\frac{\partial \pi(\Theta,w,\lambda)}{\partial \lambda}}{\frac{\partial U(\Theta,w,\lambda)}{\partial \lambda}} < \frac{\frac{\partial \pi(\Theta,w,\lambda)}{\partial w}}{\frac{\partial U(\Theta,w,\lambda)}{\partial w}} = -1 \tag{37}$$

The rationale for this inequality is that reducing the stringency of the noncompete agreement is more costly for the firm compared to increasing wages. This is because the potential damage to the firm from a less stringent noncompete outweighs the benefits an employee might gain by joining a competitor. In essence, the firm's profit would decrease more by relaxing the noncompete terms than by offering additional monetary compensation through higher wages

If $\alpha > 1$ the opposite is true as the previous argument can be reversed.

$$\frac{\frac{\partial \pi(\Theta,w,\lambda)}{\partial \lambda}}{\frac{\partial U(\Theta,w,\lambda)}{\partial \lambda}} > \frac{\frac{\partial \pi(\Theta,w,\lambda)}{\partial w}}{\frac{\partial U(\Theta,w,\lambda)}{\partial w}} = -1 \tag{38}$$

The next two graphs summarizes the optimal contracts.

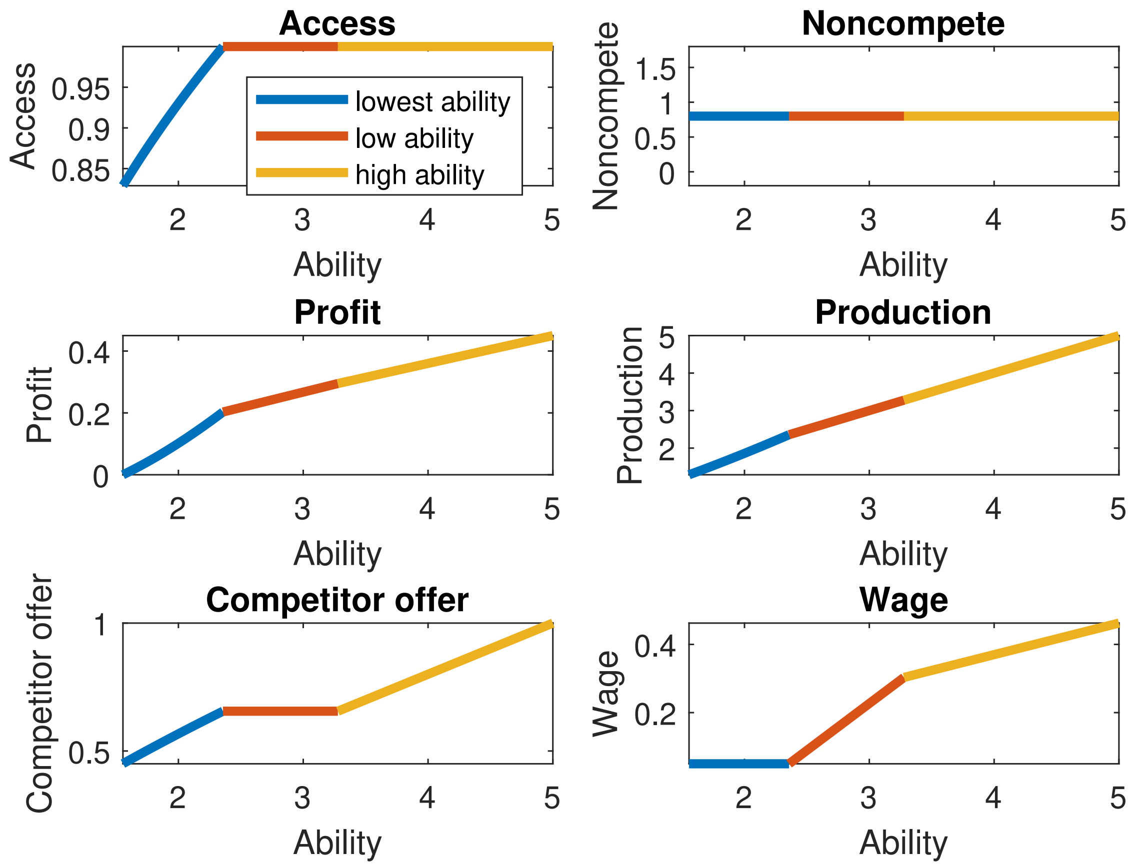

Figure 6: Optimal contract with minimum wage with $\alpha < 1$

Figure 7 shows that the optimal contract features compensation via increasing wage if $\alpha < 1$ for employees with ability $\tilde{A}(w, \alpha) < A$.

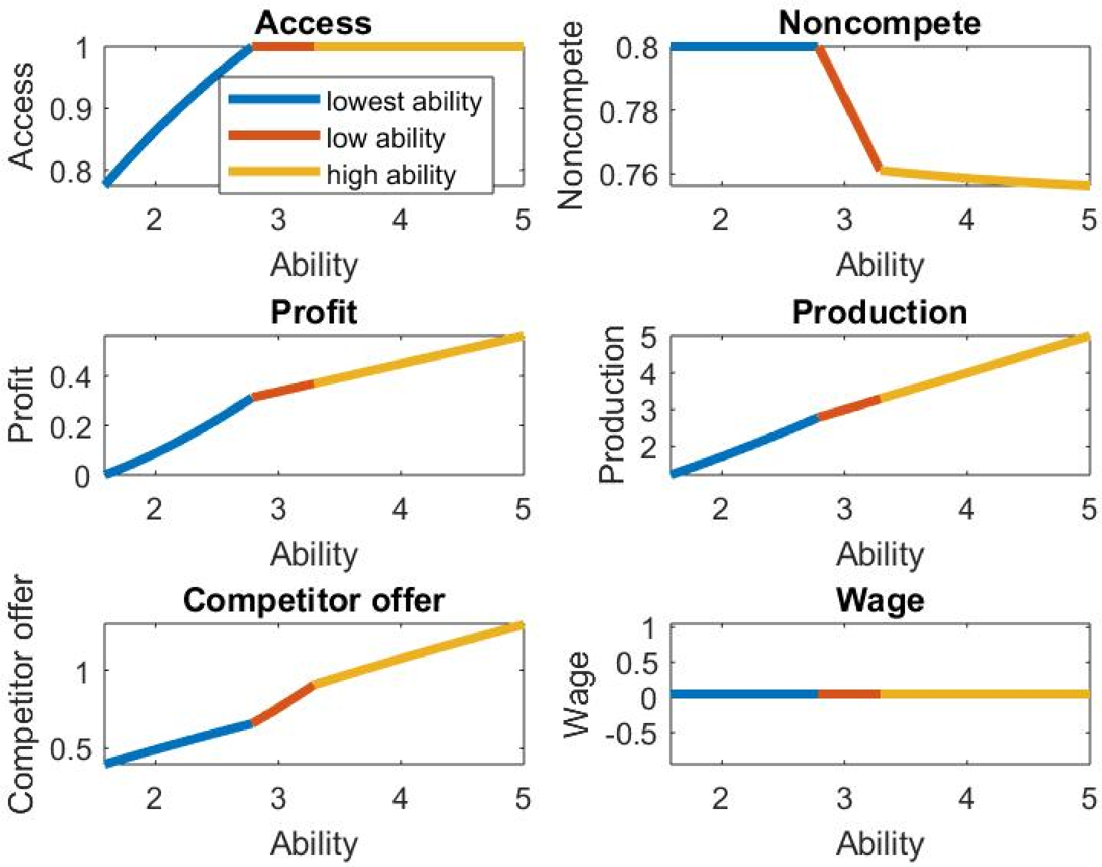

Figure 7: Optimal contract with minimum wage with high $\alpha > 1$

Figure 8 shows that the optimal contract features compensation via a laxer noncompete if $\alpha > 1$ for employees with ability $\tilde{A}(w, \alpha) < A$.

In summary, if the value of α is greater than one, indicating that the employee has favorable outside options, the optimal contract includes compensation through a laxer noncompete. Conversely, if α is less than one, the noncompete is set to be as stringent as possible. Specifically, for high ability employees who are given maximum access to the firm's critical assets, the stringency of the noncompete may vary based on their outside option. These findings support the empirical results of Kini et al. [2019], who found that 'CEOs are less likely to have (strict) non-competition agreements if they face a greater personal cost and more likely when the firm expects to suffer greater harm if departing CEOs work with competitors' (p.1).

4.2 Wage to induce staying

This section explores the possibility of the firm offering a state-contingent wage dependent on the match quality. The primary focus is on the wage that encourages the employee to stay even in a bad-match state to mitigate potential damages caused to the firm.

For low ability agents, the firm's objective is as follows:

$$\pi_L(\lambda, \Theta, w, A, \alpha) = p(1-\beta)(A\Theta + (1-\alpha)(1-\lambda)\bar{A}\Theta^2) - w \tag{39}$$

subject to the constraint that the wage is at least as high as the value of the outside option of the employee in the bad state:

$$w \geq \alpha(1-\lambda)\bar{A}\Theta^2 \tag{40}$$

If the wage is lower than the outside option of the employee in the bad state, the employee will leave, reverting to the previously discussed problem. However, if the constraint in equation (40) is strictly exceeded, it implies the firm is overpaying the employee. Therefore, to ensure the employee stays without overpayment, this constraint should be met exactly

Furthermore, if the firm pays no wage, its cost is the damage, $(1-\lambda)\bar{A}\Theta^2$. Therefore, the firm offers a wage that induces the employee to stay if:

$$(1-\lambda)\bar{A}\Theta^2 \leq \alpha(1-\lambda)\bar{A}\Theta^2 = w \tag{41}$$

This condition holds if $\alpha \leq 1$. If $\alpha > 1$, the firm does not offer a competitive wage for the employee's outside option, as the employee causes less harm than the wage would be. However, if $\alpha < 1$, the wage is $w = \alpha(1-\lambda)\bar{A}\Theta^2$, and thus the firm reduces its costs by inducing the employee to stay and, therefore, causing no damage. The firm follows the same strategy with high ability employees.

4.3 Firm size in terms of α

In this section, the firm size is analyzed with respect to α, the ratio of the employee's outside option to the firm's potential damage. Initially, the focus is on contracts with maximum access ($\Theta = 1$) for an analytical solution is possible. Subsequently, the firm size is numerically examined all (A, α) combinations.

4.3.1 Conditional on maximum access

The parameter α plays a key role in determining which agents the firm employs. With a low α, indicating limited employee benefits from external options and higher costs to the firm, there is a lower employment threshold, $\underline{\alpha}(A)$. On the other hand, if α is very high, denote it by $\bar{\alpha}(A)$, the employee's outside option is great and thus he demands a high compensation in the bargaining. Anticipating the large costs the firm does not employ such agents. The following lemma summarizes this result.

Lemma 5. *The firm size can be characterized by a lower, $\underline{\alpha}$, and upper, $\bar{\alpha}$, threshold on α.*

4.3.2 Numerical simulation

This section presents a numerical simulation of the optimal contract across various (A, α) pairs, including those for the lowest ability employees with $\Theta < 1$. Figure 8 illustrates the firm size differences between scenarios with an enforceable noncompete ($\bar{\lambda} = 0.3$, indicated by red and blue areas) and an unenforceable noncompete ($\bar{\lambda} = 0$, shown in blue). The figure demonstrates the expected range of α, marked by $\underline{\alpha}(A)$ and $\bar{\alpha}(A)$.

The analysis then extends to comparing firm sizes under enforceable and unenforceable noncompete scenarios. Notably, for each value of α, the required minimum ability level is lower when the noncompete is enforceable. The reason is that noncompete helps the firm in the bargaining phase, allowing the firm to keep a higher ratio of the surplus. Additionally, the restriction on the employee's external use of access under an enforceable noncompete enables the provision of higher access, which in turn boosts output. Consequently, the firm's size is larger in scenarios where noncompete agreements are enforceable compared to those where they are not.

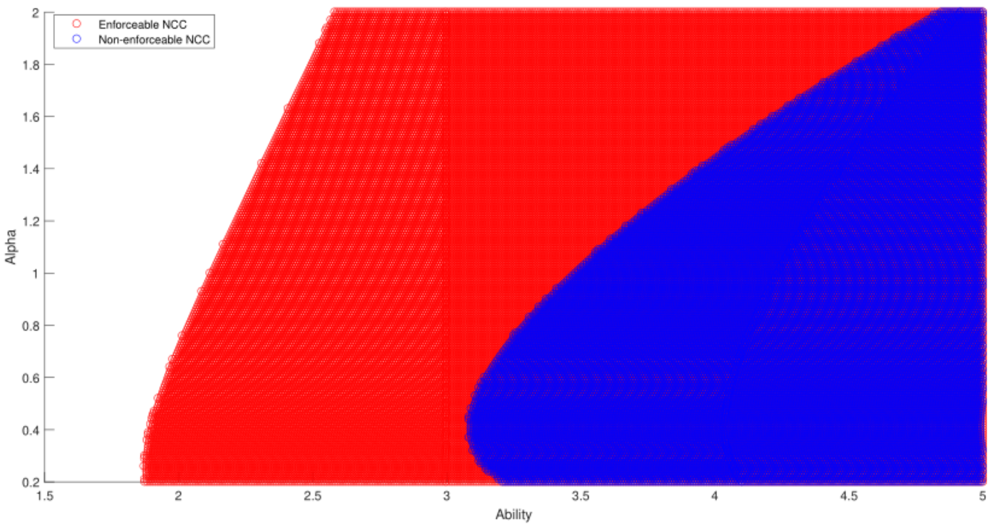

Figure 8: Firm size

Figure 9 depicts the firm size under two distinct scenarios: when noncompete agreements are enforceable, represented by the colored area with $\bar{\lambda} = 0.3$, and when they are unenforceable, indicated by the blue area. The larger value of $\bar{\lambda}$ facilitates the firm's provision of access, consequently enabling a larger firm size compared to the scenario where noncompete is not enforceable.

5 Efficiency of noncompete

This section analyzes the efficient level of the regulation of noncompete, $\bar{\lambda}$. Social welfare is defined as the sum of profit and agent's utility.[13] A regulator maximizes this social welfare by choosing $\bar{\lambda}$, taking the optimal contract (λ, Θ, w), as given. I assume that ability is nonobservable for the regulator, or, alternatively, writing different regulations for different levels of ability is too costly, thus the regulation cannot be made ability dependent. However, the regulator is able to observe α, which could represent the industry in which the firm operates or long-term prevailing market conditions.

The objective of the regulator takes the following form.

$$\begin{aligned}\max_{\bar{\lambda}} \phi(\bar{\lambda}) = &\int_{1}^{A_{min}(\bar{\lambda})} \gamma A df(A) \\ &+ \int_{A_{min}(\bar{\lambda})}^{\bar{A}(\alpha,\bar{\lambda})} pA\Theta(\bar{\lambda}) - (1-p)(1-\alpha)(1-\lambda)\bar{A}(\Theta(\bar{\lambda}))^2 df(A) \\ &+ \int_{\bar{A}(\alpha,\bar{\lambda})}^{A_{max}} pA\Theta(\bar{\lambda}) - (1-p)(1-\alpha)(1-\lambda)A(\Theta(\bar{\lambda}))^2 df(A)\end{aligned} \tag{42}$$

where F(A) is the cumulative distribution function of A with density f(A). We assume uniform distribution throughout the paper thus $F(A) = \frac{A-1}{A_{\max}}$ and $f(A) = \frac{1}{A_{\max}-1}$ The first line is the payoff of the players when there is no employment, while the rest is the sum of the payoffs arising from employment, for low and high ability respectively. Note that the wage falls out of the objective function, as the firm pays it while the employee receives it.

5.1 $\alpha \leq 1$

First consider $\alpha \leq 1$, meaning the damage of the firm is at least as high as the gain of the employee.

Lemma 6. *If $\alpha < 1$, it is optimal to set $\bar{\lambda} = 1$, that is the regulator allows the most stringent noncompete.*

Since the employee leaving the firm yields to larger costs than benefits, it is optimal to set $\bar{\lambda} = 1$, whihc in turn also incentivizes the firm to provide maximum access to the employees.

[13] I abstract from the additional profit the competitor firm may make if the agent joins them in the analysis. The reason for this is that I want to avoid that an additional player drives the results of the regulation. However, including the competitor's payoff is also possible. One could imagine that the competitor's profit increases in a similar fashion to the agent's profit, ie.: by $\delta(1-\lambda)\bar{A}\Theta$ for low ability and by $\delta A(1-\lambda)\Theta$ for high ability, where δ is a parameter reflecting the sensitivity of profitability with respect to the agent's join. The analysis could be carried out in a similar fashion to the main text, resulting in a less stringent regulation on noncompete since the competitor's profit is also a decreasing function of the stringency of the noncompete.

5.2 $\alpha > 1$

This subsection discusses the scenario when the firm's damage is lower than the employee's gain. The objective function, given the optimal contract offered by the firm, can be written as follows.

$$\begin{aligned}\max_{\bar{\lambda}} \phi(\bar{\lambda}) = &\int_{1}^{A_{min}(\bar{\lambda})} \gamma A df(A) \\ &+ \int_{A_{min}(\bar{\lambda})}^{\tilde{A}(\alpha,\bar{\lambda})} pA\Theta(\bar{\lambda}) - (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2 df(A) \\ &+ \int_{\tilde{A}(\alpha,\bar{\lambda})}^{\bar{A}(\alpha,\bar{\lambda})} p(A) - (1-p)(1-\alpha)(1-\lambda_{pc}(A<\bar{A},\alpha))\bar{A} df(A) \\ &+ \int_{\bar{A}(\alpha,\bar{\lambda})}^{A_{max}} p(A) - (1-p)(1-\alpha)(1-\lambda_{pc}(A<\bar{A},\alpha)) A df(A)\end{aligned} \tag{43}$$

After rearranging the first order condition has the following form[14]

$$\begin{aligned}&\int_{A_{min}(\bar{\lambda})}^{\tilde{A}(\alpha,\bar{\lambda})} pA\frac{\partial \Theta}{\partial \bar{\lambda}} - (1-p)(1-\alpha)\bar{A}\left(-\Theta^2(\bar{\lambda}) + (1-\bar{\lambda})2\Theta(\bar{\lambda})\frac{\partial \Theta(\bar{\lambda})}{\partial \bar{\lambda}}\right) df(A) \\ &= \frac{\partial A_{min}(\bar{\lambda})}{\partial \bar{\lambda}} f(A_{\min}) \times \left(p(\tilde{A}(\alpha,\bar{\lambda})\Theta(\bar{\lambda})) - (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2 - (\gamma A_{min}(\bar{\lambda})\right) \\ &+ \frac{\partial \tilde{A}(\alpha,\bar{\lambda})}{\partial \bar{\lambda}} f(\tilde{A}(\alpha,\bar{\lambda})) \\ &\times \left(p(\tilde{A}(\alpha,\bar{\lambda})) - (1-p)(1-\alpha)(1-\lambda_{pc}(A<\bar{A},\alpha))A - p(\tilde{A}(\alpha,\bar{\lambda})\Theta(\bar{\lambda})) + (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2\right)\end{aligned} \tag{44}$$

The right-hand side of the expression is negative because both $\frac{\partial A_{min}(\bar{\lambda})}{\partial \bar{\lambda}}$ and $\frac{\partial \tilde{A}(\bar{\lambda})}{\partial \bar{\lambda}}$ are negative. This is because the regulator maximizes welfare by making the intervals with higher production (higher access) larger. The left-hand side is broken down as follows. The first part of the expression is the direct benefit of increasing the stringency of noncompete. A more stringent noncompete incentivizes the firm to provide more access, as the employee has to be compensated for the lost outside opportunities while the firm suffers smaller damage than the employee gain. This is socially beneficial as the higher access leads to more expected production. The second part of the expression represents the effect on the damage and gain due to the competitor's offer. From the term $(1-\alpha)$, 1 refers to the firm's payoff, and α refers to the employee's payoff. An increase in $\bar{\lambda}$ has the direct effect of decreasing the outside option (Θ^2), but also has an indirect effect that, due to the larger access, the outside option is bigger

[14] The rearrangement is shown in Appendix B.8

$((1-\bar{\lambda})2\Theta(\bar{\lambda})\frac{\partial\Theta(\bar{\lambda})}{\partial\lambda)})$.

In conclusion, the regulator must trade off the benefit of strict regulation in terms of facilitating access provision and the cost that great outside options are reduced. However, unlike scenarios where $\alpha < 1$, deriving clear-cut analytical results in this context is not straightforward.

6 Conclusion

This paper developed a theoretical model to analyze the optimal degree of access and stringency of noncompete in employment contracts. We found that the lowest ability agents are subject to the strongest restrictions, while agents close to the average ability of the firm have milder covenants. However, for the high ability agents, the stringency of noncompete is not decreasing any further as these agents can make the most use of the access granted to them. An important extension of the model is allowing the employee gain from leaving to differ from the firm's damage. We found that if the employee gain is larger than the damage, with a low wage and less stringent noncompete, as it minimizes the firm's cost. However, in the reversed case, a higher wage and stringent noncompete are preferred to minimize the losses arising from the employee's departure.

We also established that the firm size is larger if the regulator enforces noncompetes. With regards to the optimal policy of regulating the stringency of noncompete, the tradeoff is between larger firm size and restricted mobility in cases when mobility would be efficient. It is optimal to regulate the maximum strength of noncompete agreement the firm can impose on the employee only if the employee's gain from joining a competitor is sufficiently larger than the firm's damage.

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A Figures

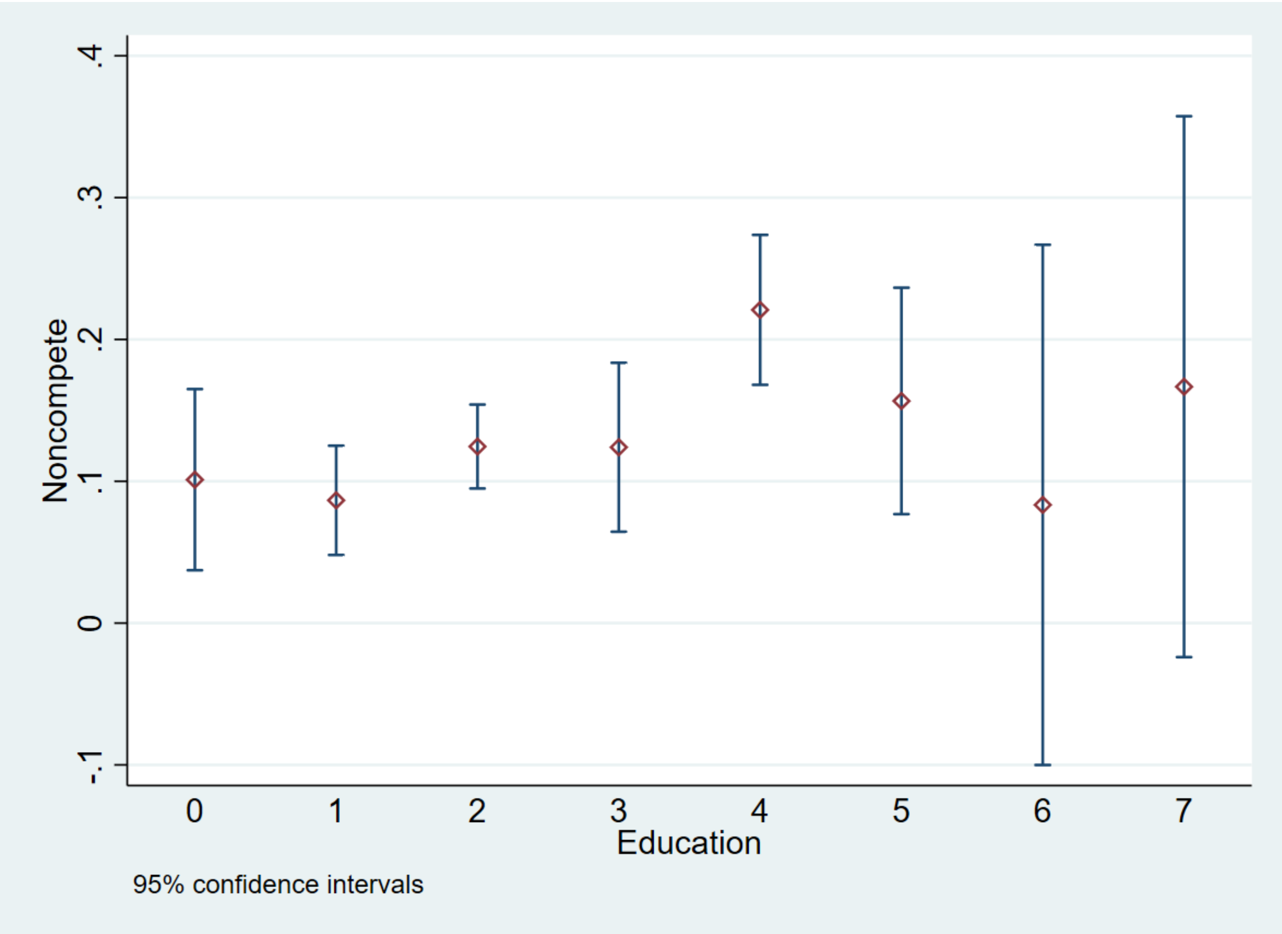

Figure 9: Noncompete as a function of education
The graph shows the noncompete frequency as a function of the employee's education.
Data source: National Longitudinal Survey of Youth Cohort 1979

B Proofs

B.1 Proof of Proposition 1

Proof. The Lagrangian becomes

$$\begin{aligned}\max_{\Theta,\lambda} L_L(\Theta,\lambda) = p(1-\beta)(A\Theta) - (1-\lambda)\bar{A}\Theta^2 \\ - \mu_1(-(p)(\beta)(A\Theta) - (1-\lambda)\bar{A}\Theta^2 + \gamma A) \\ - \mu_2(\Theta - 1) \\ - \mu_3(\lambda - \bar{\lambda})\end{aligned} \tag{45}$$

In equilibrium, there are multipliers μ_1, μ_2, μ_3, such that

$$\frac{\partial L}{\partial \Theta} = p(1-\beta)A - 2(1-\lambda)\bar{A}\Theta + \mu_1(p\beta A + 2(1-\lambda)\bar{A}\Theta) - \mu_2 = 0 \tag{46}$$

$$\frac{\partial L}{\partial \lambda} = \bar{A}\Theta^2 - \mu_1\bar{A}\Theta^2 - \mu_3 = 0 \tag{47}$$

$$\mu_1(-p(\beta)(A\Theta - y) - (1-\lambda)\bar{A}\Theta^2 + \gamma A) = 0 \tag{48}$$

$$\mu_2(\Theta - 1) = 0 \tag{49}$$

$$\mu_3(\lambda - \bar{\lambda}) = 0 \tag{50}$$

I start with part 2.) and part 3) of Proposition 1.

Case I, $\mu_3 = 0$.

It follows that $\mu_1 = 1 > 0$ and $\mu_2 = pA > 0$. Thus both the first and second constraint is binding, meaning $\Theta = 1$ and λ is calculated from the binding participation constraint.

$$\lambda = 1 - \frac{\gamma A - p\beta A}{\bar{A}} = \lambda_{\text{pc}L} \tag{51}$$

The sign of the derivative $\frac{\partial \lambda_{\text{pc}}}{\partial A}$ depends on the relation of $p\beta$ and γ which are the marginal effects of the increase in ability on the bargained ratio of the production, $p\beta$, at the firm and the marginal effect of ability under the alternative use of ability γ. If $p\beta > \gamma$, $\frac{\partial \lambda}{\partial A} > 0$ meaning as ability increases, the firm can tighten noncompete. The reason is that at higher ability the employee's payoff from the output $pA\beta$ approaches the outside option $A\gamma$.

For that reason, I make the parameter assumption that $p\beta < \gamma$ resulting in $\frac{\partial \lambda}{\partial A} < 0$. This case the firm has to decrease the level of noncompete to be able to match the participation constraint. Note that $\lambda_{\text{pc}} = \bar{\lambda}$ defines a threshold of A, $\tilde{A}$ below which the contract is not feasible due to the restriction on the stringency of the noncompete.

$$\tilde{A} = \frac{\bar{A}(1 - \bar{\lambda})}{\gamma - p\beta} \tag{52}$$

Case II, $\mu_3 > 0$

$\mu_3 > 0$ implies $\lambda = \bar{\lambda}$. Start with $\mu_2 > 0$ yielding $\Theta = 1$. If $\mu_1 > 0$ That this implies $p\beta A + (1 - \bar{\lambda})\bar{A} = \gamma A$. As $\gamma > p\beta$, the left hand side increases more in A, than the right. Hence above contract cannot be equilibrium.

If $\mu_1 = 0$, the PC may not bind. However, in this case offering $\Theta = 1$ is not optimal, since lowering Θ would yield to higher profit, while still satisfying the participation constraint. Therefore if $\mu_1 = 0$, the access corresponding multiplier must also be 0, that is $\mu_2 = 0$. If $\mu_1 = 0$, then $\Theta = \frac{p(1-\beta)A}{2(1-\bar{\lambda})\bar{A}}$, which the optimal level of access if the PC does not bind. To have an interesting model with a friction, γ must be high enough to exclude this solution. That is, $\underline{\gamma} = \frac{p^2(1-\beta)}{2(1-\bar{\lambda})}$.

$\mu_2 = 0$

If $\mu_1 > 0$, the PC binds, and Θ is defined by the PC. It yields

$$\Theta = \frac{-p\beta A + \sqrt{p^2\beta^2A^2 - 4(1 - \bar{\lambda})\bar{A}(-\gamma A)}}{2(1 - \bar{\lambda})\bar{A}} = \Theta_{pc}(L) \tag{53}$$

Note that

$$\frac{\partial \Theta_{pc}(L)}{\partial A} = -p\beta + \frac{1}{2}\frac{2A\beta^2p^2 + 4(1 - \bar{\lambda})\bar{A}\gamma}{\sqrt{p^2\beta^2A^2 - 4(1 - \bar{\lambda})\bar{A}(-\gamma A)}} > 0 \tag{54}$$

Since after simplification it yields $4(1 - \bar{\lambda})^2\bar{A}^2\gamma^2 > 0$

The threshold of A can be calculated from $\Theta_{pc} = \bar{\Theta}$ resulting the same $\tilde{A}$ as before.

$$\tilde{A} = \frac{\bar{\Theta}^2\bar{A}(1 - \bar{\lambda})}{p(\gamma - \beta)} \tag{55}$$

For $A < \tilde{A}$, only $\Theta = \Theta_{\text{pc}}$ and $\lambda = \bar{\lambda}$ is feasbile, while is feasible, while for $A > \tilde{A}$ only only $\Theta = 1$ and $\lambda = \lambda_{\text{pc}}$. Thus part 2 and part 3 of the proposition is proven.

□

B.2 Proof of Proposition 2

Proof. For high ability agents the damage and gain functions depends on $A > \bar{A}$. The problem of the firm is the following

$$\max_{\Theta,\lambda} = \pi_H(\Theta, \lambda)p(1-\beta)(A\Theta) - (1-\lambda)A\Theta^2 \tag{56}$$

s.t

$$p\beta(A\Theta) + (1-\lambda)A\Theta^2 \geq \gamma A \tag{57}$$

$$\Theta \leq 1 \tag{58}$$

$$\lambda \leq \bar{\lambda} \tag{59}$$

The Lagrangian hence reads

$$\begin{aligned} \max_{\Theta,\lambda} L_H(\Theta, \lambda) = p(1-\beta)(A\Theta) - (1-\lambda)\Theta^2 \\ - \mu_1(-p\beta(A\Theta) - (1-\lambda)\Theta^2 + \gamma A) \\ - \mu_2(\Theta - 1) \\ - \mu_3(\lambda - \bar{\lambda}) \end{aligned} \tag{60}$$

There are multipliers μ_i such that

$$\frac{\partial L}{\partial \Theta} = p(1-\beta)A - 2(1-\lambda)A\Theta + \mu_1(p\beta A + 2(1-\lambda)A\Theta) - \mu_2 = 0 \tag{61}$$

$$\frac{\partial L}{\partial \lambda} = A\Theta^2 - \mu_1 A\Theta^2 - \mu_3 = 0 \tag{62}$$

$$\mu_1(-p(\beta)(A\Theta - y) - (1-\lambda)A\Theta^2 + \gamma A) = 0 \tag{63}$$

$$\mu_2(\Theta - 1) = 0 \tag{64}$$

$$\mu_3(\lambda - \bar{\lambda}) = 0 \tag{65}$$

The solution looks similar to the proof of Proposition 1.
Case I with $\mu_3 = 0$
It yields to $\mu_1 = 1 > 0$ and $\mu_2 = pA > 0$. Thus $\Theta = 1$ and

$$\lambda = 1 - \frac{\gamma A - p\beta A}{A} = 1 - \gamma + p\beta = \lambda_{\text{pc}}(A > \bar{A}) \tag{66}$$

Note that as $\frac{\partial \lambda}{\partial A} = 0$, the optimal stringency of noncompete is not dependent on ability for high ability employees.
Case II $\mu_3 > 0$
In which case $\lambda = \bar{\lambda}$.
Start with $\mu_2 > 0$, leading to $\Theta = 1$. As in the previous case, PC is binding otherwise firm could lower Θ. However, the PC, $p\beta A + (1-\bar{\lambda})A$, is linear in A, so the contract can only be optimal for the whole range of $A \in (\bar{A}, A_{\max})$ if $p\beta + (1-\bar{\lambda}) = \gamma$, which equation depends on the exogenous parameters. Rewriting yields $\bar{\lambda} = 1 - \gamma - p\beta$ which is the same as (66) with $\lambda = \bar{\lambda}$

Next, consider $\mu_2 = 0$. If $\mu_1 > 0$, PC binds and it defines access

$$\Theta = \frac{-p\beta A + \sqrt{p^2\beta^2 A^2 - 4(1-\bar{\lambda})A(-\gamma A)}}{2(1-\bar{\lambda})A} = \Theta_{pc,H} \tag{67}$$

The two contracts that solve the problem are $(1, \lambda_{\text{pc}}(A > \bar{A}))$ and $\Theta_{pc,H}, \bar{\lambda}$. In both cases, the employee is pushed to the participation constraint. Thus the one with higher access that yields to higher production is the one the firm chooses to offer.
Therefore, for $\bar{A} < A < A_{\max}$, the optimal contract is $(\lambda_{\text{pc}}, 1)$, where (λ_{pc}) is defined from the binding participation constraint and is not dependent on A. □

B.3 Proof of Proposition 3

Proof. Calculating the access from the participation constraint of the agent gives

$$\Theta_{\alpha,\text{pc}} = \frac{-p\beta A + \sqrt{p^2\beta^2 A^2 + 4(\alpha(1-\bar{\lambda})\bar{A} + p\beta(1-\bar{\lambda})\bar{A}(1-\alpha))(\gamma A)}}{2(\alpha(1-\bar{\lambda})\bar{A} + p\beta(1-\bar{\lambda})\bar{A}(1-\alpha))} \tag{68}$$

Substituting in above access for the profit yields the following equation

$$\pi(A, \alpha, \Theta_{\alpha,\text{pc}}) = A^2_{min,\alpha} p^2(1-\beta)[(1-\beta)\alpha + \beta] - (1-\bar{\lambda})\bar{A}\gamma[1 - p(1-\beta)(1-\alpha))]^2 = 0 \tag{69}$$

Differentiating above with respect to $A_{min,\alpha}$ and α yields

$$\frac{\pi(A, \alpha, \Theta_{\alpha,\text{pc}})}{\partial A_{min,\alpha}} = 2A_{min,\alpha} p^2(1-\beta)[(1-\beta)\alpha + \beta] - \frac{1}{2}(1-\bar{\lambda})\gamma[1 - p(1-\beta)(1-\alpha))]^2 \tag{70}$$

$\frac{\partial\pi(A,\alpha,\Theta_{\alpha,\text{pc}})}{\partial A_{min,\alpha}} > 0$ if $(p, (1-\beta))$ high enough.

$$\frac{\partial\pi(A, \alpha, \Theta_{\alpha,\text{pc}})}{\partial\alpha} = A^2_{min,\alpha} p^2(1-\beta)^2 - 2(1-\bar{\lambda})\gamma\bar{A}[1 - p(1-\beta)(1-\alpha))]p(1-\beta) \tag{71}$$

The expression is highest in terms of α, if $\alpha = 0$.

$$\frac{\partial\pi(A, \alpha, \Theta_{\alpha,\text{pc}})}{\partial\alpha}|(\alpha = 0) = A^2_{min,\alpha} p(1-\beta) - 2(1-\bar{\lambda})\gamma\bar{A}[1 - p(1-\beta) \tag{72}$$

This expression is positive, if $(p, (1-\beta))$ high enough. As α goes up, the expression becomes negative after a threshold (α^T). Calculating the derivative implicitly,

$$\frac{\partial A_{min,\alpha}}{\partial\alpha} = -\frac{\frac{\partial\pi(A,\alpha,\Theta_{\alpha,\text{pc}})}{\partial\alpha}}{\frac{\partial\pi(A,\alpha,\Theta_{\alpha,\text{pc}})}{\partial\alpha}} \tag{73}$$

yields to the proposition. □

B.4 Proof of Lemma 3

Proof.

$$\frac{\partial\pi(A, \alpha, \Theta_{\alpha,\text{pc}}}{\partial\bar{\lambda}} = \bar{A}\gamma[1 - p(1-\beta)(1-\alpha))] > 0 \tag{74}$$

As a result $\frac{\partial A_{min,\alpha}}{\partial\bar{\lambda}} < 0$. □

B.5 Proof of Proposition 4

Proof. There are multipliers μ_i such that

$$\frac{\partial L}{\partial \Theta} = p(1-\beta)(A+2(1-\alpha)(1-\lambda)\bar{A}\Theta)-2(1-\lambda)\bar{A}\Theta+\mu_1(p\beta(A+2(1-\alpha)(1-\lambda)\bar{A}\Theta)+2\alpha(1-\lambda)\bar{A}\Theta)-\mu_2 = 0 \tag{75}$$

$$\frac{\partial L}{\partial \lambda} = -p(1-\beta)(1-\alpha)\bar{A} - \mu_1 p\beta(1-\alpha)\bar{A} + \bar{A}\Theta^2 - \bar{A}\alpha\mu_1\Theta^2 - \mu_3 = 0 \tag{76}$$

$$\frac{\partial L}{\partial w} = -1 + \mu_1 + \mu_4 = 0 \tag{77}$$

$$\mu_1(-p(\beta)(A\Theta - y) - (1-\lambda)\bar{A}\Theta^2 - w + \gamma A = 0 \tag{78}$$

$$\mu_2(\Theta - \bar{\Theta}) = 0 \tag{79}$$

$$\mu_3(\lambda - \bar{\lambda}) = 0 \tag{80}$$

$$\mu_4(\underline{w} - w) = 0 \tag{81}$$

If $\mu_3 = 0$, simplifying $\frac{\partial L}{\partial \lambda}$ yields to

$$\mu_1 = \frac{1 - p(1-\beta)(1-\alpha)}{p\beta(1-\alpha)+\alpha} \tag{A.1}$$

Note also that from $\frac{\partial L}{\partial w}$ it follows that

$$\mu_1 = 1 - \mu_4 \tag{82}$$

and thus $\mu \leq 1$

If $\alpha < 1$ (A.1) cannot be met. Thus $\mu_3 > 0$, leading to $\lambda = \bar{\lambda}$. $\alpha = 1$ leads the case discussed before.

If $\alpha > 1$, $\mu_1 < 1$ and thus $\mu_4 > 0$. Thus $w = \underline{w}$ and λ is calculated from the binding participation constraint.

$$\lambda_{\text{pc}}(A < \bar{A}, \alpha) = 1 - \frac{\gamma A - \underline{w} - p\beta A}{\bar{A}(p\beta(1-\alpha)+\alpha} \tag{83}$$

If $\mu_3 > 0$, (A.1) becomes

$$\mu_1 = \frac{1 - p(1-\beta)(1-\alpha) - \frac{\mu_3}{\bar{A}}}{p\beta(1-\alpha)+\alpha)} \tag{84}$$

Which leads to all constraint binding, ie.: the contract is independent of ability. Note that this leads to contradiction as the participation constraint is a function of ability. [15]

Note that at high ability, $A > \bar{A}$, the noncompete changes to

$$\lambda_{\text{pc}}(A > \bar{A}, \alpha) = 1 - \frac{\gamma A - \underline{w} - p\beta A}{A(p\beta(1-\alpha)+\alpha)} \tag{85}$$

□

Furthermore the binding participation constraint for part 2) is

$$\Theta_{\alpha,\text{pc}} = \frac{-p\beta A + \sqrt{p^2\beta^2 A^2 + 4(\alpha(1-\bar{\lambda})\bar{A} + p\beta(1-\bar{\lambda})\bar{A}(1-\alpha))(\gamma A - \underline{w})}}{2(\alpha(1-\bar{\lambda})\bar{A} + p\beta(1-\bar{\lambda})\bar{A}(1-\alpha))} \tag{86}$$

[15] Technically we could make $\mu_1 = 0$ so that the PC would not bind but that is not of particular interest

Part 1) follows the same logic as before, we elaborate on it in the section 5.3.
Moreover $\Theta_{\alpha,\text{pc}} = 1$ if

$$\tilde{A}_\alpha = \frac{(\alpha(1-\bar{\lambda})\bar{A} + p\beta(1-\bar{\lambda})\bar{A}(1-\alpha) + w}{p(\gamma-\beta)} \tag{87}$$

$$w_{\text{pc,L}} = p\beta(A\Theta + (1-\alpha)(1-\lambda)\bar{A}\Theta^2) + \alpha(1-\lambda)\bar{A}\Theta^2 - \gamma A \tag{88}$$

$$w_{\text{pc,H}} = p\beta(A\Theta + (1-\alpha)(1-\lambda)A\Theta^2) + \alpha(1-\lambda)A\Theta^2 - \gamma A \tag{89}$$

$$\begin{aligned}&\frac{\partial\Theta_{\alpha,\text{pc}}}{\partial\bar{\lambda}} = \\ &\frac{-0.5(p^2\beta^2A^2 + 4((1-\bar{\lambda})\bar{A}(\alpha + p\beta(1-\alpha)(\gamma A - \underline{w}))^{-0.5}(4\bar{A}(\alpha+p\beta(1-\alpha))(\gamma A - \underline{w})}{(2(1-\bar{\lambda})\bar{A}(\alpha+p\beta(1-\alpha)))} \\ &+ \frac{(-p\beta A + \sqrt{p^2\beta^2A^2 + 4(\alpha(1-\bar{\lambda})\bar{A} + p\beta(1-\bar{\lambda})\bar{A}(1-\alpha)(\gamma A - \underline{w})})(2\bar{A}(\alpha+p\beta(1-\alpha)))}{(2(1-\bar{\lambda})\bar{A}(\alpha+p\beta(1-\alpha))^2} > 0\end{aligned} \tag{90}$$

B.6 Proof of Lemma 5

Proof. Denote the ability level for which the optimal contract is $\Theta = 1$, $\lambda = \bar{\lambda}$ and $w = \underline{w}$ by A^F. Note that A^F exists independent of the value of α, as it only influences the exact level of ability for which this is the optimal contract. The firm's profit that has to be at least as large as the participation constraint is given by

$$\pi_L = p(1-\beta)(A + (1-\alpha)(1-\bar{\lambda})\bar{A}) - (1-\bar{\lambda})\bar{A} - \underline{w} \geq 0 \tag{91}$$

$$\pi(A \geq \bar{A}) = p(1-\beta)(A + (1-\alpha)(1-\bar{\lambda})A) - (1-\bar{\lambda})A - \underline{w} \geq 0 \tag{92}$$

with low and high ability employees respectively. The upper threshold on α is

$$\bar{\alpha}_L = 1 - \frac{\bar{A}(1-\bar{\lambda}) - p(1-\beta)A - \underline{w}}{p(1-\beta)\bar{A}(1-\bar{\lambda})} > 1 \tag{93}$$

and

$$\bar{\alpha}(A \geq \bar{A}) = 1 - \frac{A(1-\bar{\lambda}) - p(1-\beta)A - \underline{w}}{p(1-\beta)A(1-\bar{\lambda})} > 1 \tag{94}$$

The participation constraint of the employee for low and high ability respectively are

$$U_L = p\beta(A - y + (1-\alpha)(1-\bar{\lambda})\bar{A}) + \alpha(1-\bar{\lambda})\bar{A} + \underline{w} \geq \gamma A \tag{95}$$

$$U(A \geq \bar{A}) = p\beta(A - y + (1-\alpha)(1-\bar{\lambda})\bar{A}) + \alpha(1-\bar{\lambda})\bar{A} + \underline{w} \geq \gamma A \tag{96}$$

The lower threshold becomes

$$\underline{\alpha}_L = \frac{\gamma A - p\beta A - (1-\bar{\lambda})\bar{A}p\beta - \underline{w}}{(1-\bar{\lambda})\bar{A}(1-p\beta)} \tag{97}$$

$$\underline{\alpha}(A \geq \bar{A}) = \frac{\gamma A - p\beta A - (1-\bar{\lambda})Ap\beta - \underline{w}}{(1-\bar{\lambda})A(1-p\beta)} \tag{98}$$

For $A > A^F$ the optimal contract changes. If $\alpha > 1$, the noncompete stringency is decreased as ability increases. If $\alpha < 1$ the wage is increased. I focus on $A > A^F > \bar{A}$ and $\alpha > 1$ to derive a relevant upper bound $\bar{\alpha}(A > A^F > \bar{A})$ with the optimal contract ($\Theta = 1, \lambda = \lambda_{\text{pc}}(A > \bar{A}), w = \underline{w}$).

$$\bar{\alpha}(A > A^F > \bar{A}) = \frac{2p^2\beta(1-\beta)(A) - \underline{w}(1+2p\beta-p) + (1-p(1-\beta))\gamma A}{\gamma Ap(1-\beta) + p\beta\underline{w} + (A)(p^2\beta(1-\beta)-p)} \tag{99}$$

Note that $\frac{\partial\bar{\alpha}(A>A^F>\bar{A})}{\partial A} > 0$, meaning that higher ability agents are employed even when their outside option is better, as they are more productive.
For $\alpha < 1$, $\bar{A} > A > A^F$, for increasing ability the wage is increased which does not affect production/outside option, thus the lower bound remains unchanged. $\frac{\partial\alpha_L}{\partial A} > 0$ with similar argument as before.

□

B.7 Proof of Lemma 6

Proof. The first term of the second and third lines are positive, while the second term is at most 0. Moreover, the firm chooses $\lambda = \bar{\lambda}$ irrespective of ability. Given that $\frac{\partial\Theta(\bar{\lambda})}{\partial\bar{\lambda}} \geq 0$ and if $\Theta = 1$, $\frac{1}{\partial\bar{\lambda}} = 0$, it is optimal from the regulator to choose $\bar{\lambda} = 1$. In that case, access is maximized making the first term as large as possible. The second term becomes 0, which is the maximum of that expression. The optimal degree of access is $\Theta = 1$, as the employee cannot inflict damages on the firm. □

B.8 Rearranging first order condition of equation 43

The first order condition reads

$$\begin{aligned}
\frac{\partial\phi(\bar{\lambda})}{\partial\bar{\lambda}} &= \frac{\partial A_{min}(\bar{\lambda})}{\partial\bar{\lambda}}(\gamma A_{min}(\bar{\lambda}))f(A_{\min})) \\
&+ \frac{\partial\tilde{A}(\alpha,\bar{\lambda})}{\partial\bar{\lambda}}\left(p(\tilde{A}(\alpha,\bar{\lambda})\Theta(\bar{\lambda})) - (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2\right)f(\tilde{A}(\alpha,\bar{\lambda})) \\
&- \frac{\partial A_{min}(\bar{\lambda})}{\partial\bar{\lambda}}\left(p(\tilde{A}(\alpha,\bar{\lambda})\Theta(\bar{\lambda})) - (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2\right)f(A_{\min}) \\
&+ \int_{A_{min}(\bar{\lambda})}^{\tilde{A}(\alpha,\bar{\lambda})} pA\frac{\partial\Theta}{\partial\bar{\lambda}} - (1-p)(1-\alpha)\bar{A}\left(-\Theta^2(\bar{\lambda}) + (1-\bar{\lambda})2\Theta(\bar{\lambda})\frac{\partial\Theta(\bar{\lambda})}{\partial\bar{\lambda}}\right)dF(A) \\
&- \frac{\partial\tilde{A}(\alpha,\bar{\lambda})}{\partial\bar{\lambda}}\left(p(\tilde{A}(\alpha,\bar{\lambda}) - y) - (1-p)(1-\alpha)(1-\lambda_{pc}(A < \bar{A},\alpha))\bar{A}(\alpha,\bar{\lambda})\right)f(\tilde{A}(\alpha,\bar{\lambda})) \\
&+ \frac{\partial\bar{A}(\alpha,\bar{\lambda})}{\partial\bar{\lambda}}\left(p(\bar{A}(\alpha,\bar{\lambda}) - y) - (1-p)(1-\alpha)(1-\lambda_{pc}(A < \bar{A},\alpha))A+\right)\bar{A}(\alpha,\bar{\lambda})f(\tilde{A}(\alpha,\bar{\lambda})) \\
&- \frac{\partial\bar{A}(\alpha,\bar{\lambda})}{\partial\bar{\lambda}}\left(p(\bar{A}(\alpha,\bar{\lambda}) - y) - (1-p)(1-\alpha)(1-\lambda_{pc}(A < \bar{A},\alpha))A+\right)\bar{A}(\alpha,\bar{\lambda})f(\tilde{A}(\alpha,\bar{\lambda})) = 0
\end{aligned} \tag{100}$$

After rearranging the first order condition has the following form

$$\int_{A_{min}(\bar{\lambda})}^{\tilde{A}(\alpha,\bar{\lambda})} pA\frac{\partial\Theta}{\partial\bar{\lambda}} - (1-p)(1-\alpha)\bar{A}\left(-\Theta^2(\bar{\lambda}) + (1-\bar{\lambda})2\Theta(\bar{\lambda})\frac{\partial\Theta(\bar{\lambda})}{\partial\bar{\lambda}}\right) dF(A)$$
$$= \frac{\partial A_{min}(\bar{\lambda})}{\partial\bar{\lambda}} f(A_{\min}) \times \left(p(\tilde{A}(\alpha,\bar{\lambda})\Theta(\bar{\lambda})) - (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2 - (\gamma A_{min}(\bar{\lambda})\right)$$
$$+ \frac{\partial\tilde{A}(\alpha,\bar{\lambda})}{\partial\bar{\lambda}} f(\tilde{A}(\alpha,\bar{\lambda}))$$
$$\times \left(p(\tilde{A}(\alpha,\bar{\lambda})) - (1-p)(1-\alpha)(1-\lambda_{pc}(A<\bar{A},\alpha))A - p(\tilde{A}(\alpha,\bar{\lambda})\Theta(\bar{\lambda})) + (1-p)(1-\alpha)(1-\bar{\lambda})\bar{A}(\Theta(\bar{\lambda}))^2\right) \tag{101}$$

All parts of the expression build on the tradeoff between the outside option and access provision. The main text elaborates on the tradeoff more.

C Parameter values

	Figure 3	Figure 4	Figure 5	Figure 6	Figure 7	Figure 8	Figure 9
p	0.7	0.8	0.8	0.7	0.5	0.5	0.6
β	0.5	0.2	0.2	0.5	0.25	0.7	0.25
$A_{\min}$	1	1	1	1	1	1	1
$A_{\max}$	5	5	5	5	5	5	5
y	0.05	0.05	0.05	0.05	0.05	0.05	0.05
$\bar{(A)}$	3	3	3	3	3	3	3
$\bar{\Theta}$	1	1	1	1	1	1	1
$\bar{\lambda}$	0.8	0.2	0	0.8	0.8	0.8	0,0.3
γ	0.6	0.6	0.6	0.6	0.4	0.4	0.2
$\underline{w}$	-	-	-	0.05	0.05	0.05	0.05
α	1	1	1	1	.9	1.1	varies

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