Human Capital and Mobility in the Executive Labor Market[*]

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Abstract

We estimate a search model of executive careers, allowing for general and firm-specific human capital accumulation, firm and executive heterogeneity, and both internal and external CEO promotions. Our model can rationalize observed patterns in CEO hiring and wages. Wage growth over the manager's career is decomposed into contributions from general and firm-specific human capital accumulation, and job search via mobility and contract renegotiation (upward revisions in wages from on-the-job search). We also further study the impact of firm-specific skill (relative to general skill and firm-side heterogeneity) on the search components (mobility and contract renegotiation) of managerial wage growth.

Keywords: CEOs, the market for CEOs, executive pay, executive mobility, human capital accumulation, on-the-job search, structural estimation, firm-specific human capital

[*]This paper is a work in progress and reuslts are subject to change, all errors are our own.

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1. Introduction

Two important patterns exist in the market for CEOs at public companies in the US. First, CEO pay has increased dramatically since the mid-1990s (e.g., Bebchuk and Fried, 2006). Second, over the same time period, around 70% of new CEOs are internally promoted and only a small percentage of external hires are poached CEOs (Graham et al., 2020; Cziraki and Jenter, 2022).[1] In further evidence, Figure 1 displays average mobility and wage growth over CEO tenure. The pattern shows that, though CEO wages see strong positive growth over the first 10 years as CEO, the likelihood of a CEO taking their outside option decays quickly over the first years of tenure.

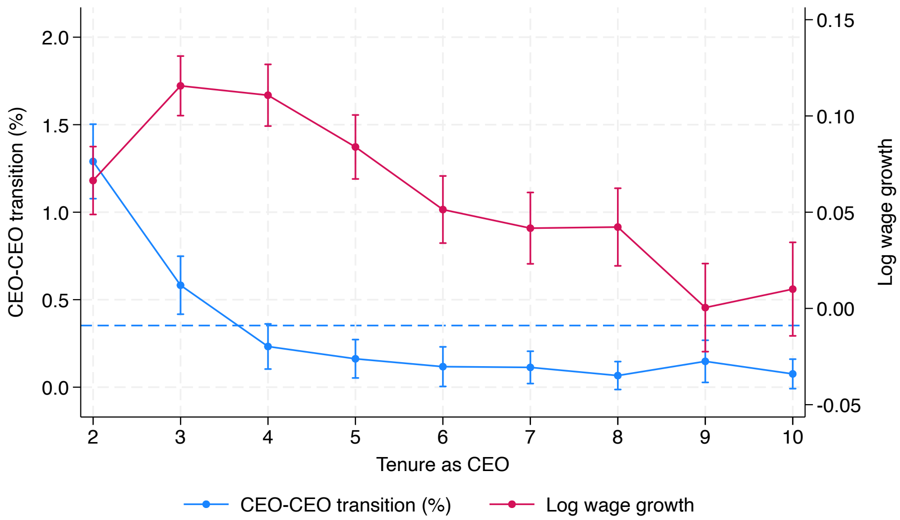
Prevailing theories explaining the rise in pay require either competitive assignment of CEOs to firms (Gabaix and Landier, 2008), stress the importance of generalist, transferable human capital (Murphy and Zabojnik, 2007), or both. Both aspects would imply significantly more transfer of CEOs across firms, at odds with the observed preference for internal hires, low CEO mobility and strong wage growth over CEO careers.

The observed preference for internal hires and low CEO mobility suggest that firm-specific human capital is a more important determinant of executive mobility and compensation than previously considered (Cziraki and Jenter, 2022). However, a premium on firm-specific capital is not directly separable from an agency cost that induces a preference for insiders, and firm-specific managerial skill must be measured relative to general skill.

This paper's goal is to undertake a joint, quantitative analysis of mobility and wage growth over executive careers that incorporates these separate motivations for managerial mobility and wage profiles. We pose and estimate a structural model of executive careers with on-the-job search, internal and external promotion, general and firm-specific human capital accumulation, executive bargaining power, and executive and firm heterogeneity. Managers in the model may be employed as a (non-CEO) executive or as the CEO of the firm. Over their careers, executives

[1] Cziraki and Jenter (2022) show that 75% of new CEOs at S&P500 firms are internal hires from 1994-2012, and a large proportion of external hires are known to the Board (either a former executive, or a Board member). Graham et al. (2020) show that 68% of new CEOs are internal hires (a current or previous officer of the firm) for a fuller sample of NYSE/Amex firms from 1933-2011.

Figure 1. CEO mobility and compensation growth across CEO tenure
This figure displays the estimated percentage of CEO-CEO transitions (left y-axis) and year-over-year wage growth (right y-axis) across tenure as CEO. All Execucomp CEOs with valid compensation (TDC1) and with a tenure lasting more than one year are included. CEOs that are promoted or externally hired start with tenure $\tau = 1$, and we display mobility and wage growth starting at $\tau = 2$. Each regression includes CEO and firm fixed effects; standard errors are clustered by CEO. The CEO-CEO transition rate is relative to the total number of CEOs of tenure τ, and the blue dashed line displays the unconditional transition rate (0.35%). We exclude $\tau = 1$ as TDC1 tends to be front-loaded with the expected value of incentive pay associated with the new CEO contract.



may receive job offers — to move horizontally, be promoted internally to CEO, or be promoted externally to CEO; the arrival rates of these job offers differ and are estimated in the data. CEOs may also receive job offers to be CEOs at other firms.

We follow an important strand of the labor economics search literature (Postel-Vinay and Robin, 2002; Cahuc et al., 2006; Bagger et al., 2014) and model wage contracts as piece-rate contracts: managers receive a portion $R \in [0, 1]$ of their contribution to firm output. When a manager receives an attractive outside offer, the incumbent and poaching firm may bargain over the executive's services (in the spirit of Rubinstein, 1982). Firm-switching events occur when the poaching firm values the manager more than the incumbent. On-the-job search leads to stochastic, discrete increases in pay via as firms bargaining over managerial services, even if the manager ultimately stays in their current position.

Our model is inspired most by Bagger et al. (2014) We adapt their setting to allow for firm-specific human capital (in addition to general) and to allow for both external and internal promotion of executives. Indeed, modeling internal and external promotions as separate events allows us to separate out a preference for insiders from firm-specific human capital.

While our main goal is empirical, the key theoretical insight from the model is that firm-specific human capital accumulation leads to increased match-specific productivity between the firm and manager. The manager thus becomes more valuable to the firm over their tenure, making them less likely to be tempted away by poaching offers. We term this the "job lock effect" of firm-specific human capital — mobility (across firms) is dampened and managers are less likely to take up outside offers to improve their wage profiles. However, to compensate for this decreased mobility, managers benefit from an "option value of renegotiation." This means that the value the executive derives from contract renegotiation (fielding outside job offers which improve his current contract) *increases* over time. Firm-specific human capital increases the likelihood that the incumbent firm is willing to match attractive outside offers.

We estimate the model on a rich panel of executive careers spanning 1992-2023 (Execucomp), combined with manually-collected data on executive tenures at firms and their experience in the executive labor market. This allows us to track managerial experience, tenure, compensation and mobility over their entire careers as executives. Transitions of executives (non-CEO and CEO) across firms, and the resultant impacts on wages and mobility, allow us to separately identify general and firm-specific components of executive human capital.

Our estimation produces two key outcomes. First, we can decompose managerial human capital into its general and firm-specific components. This is a standing open question in corporate governance and the answer has important consequences for the literature on executive compensation (e.g., Gabaix and Landier, 2008; Custódio et al., 2013; Cziraki and Jenter, 2022).

Second, we can decompose wage growth over executive careers into its key components: managerial bargaining power, general and firm-specific human capital accumulation, mobility effects (job-hopping), and contract renegotiation (upward revisions in wages caused by on-the-job search). Our model also allows us to study the impact of firm-specific skill (relative to general skill and also relative to any firm-side heterogeneity) on both mobility and contract renegotiation.

As far as we know, no paper has jointly studied the impact of these forces on managerial wage profiles.

1.1. Literature Review

2. Model

2.1. Environment

The model is in continuous time, and features a unit mass of managers who need to join a continuum of firms to produce and thus receive a wage. When matched with a firm, a manager can be a non-CEO executive or the firm's chief executive officer (CEO). We refer to non-CEO executives as “executives" to differentiate from CEOs. Firms operate at constant returns to scale, and are modeled as a collection of managerial positions — each firm has a CEO and also features several executives. Each executive (CEO) position is either vacant and looking for a worker or occupied.

Each manager i can be in a state of unattachment, indexed by U, in which they do not currently work in an executive position at a firm. They can also be in executive or CEO employment, indexed respectively by $j \in \{E, C\}$. Each managerial position within a firm has a position productivity p_j, which we index by j to denote that productivity can vary across positions within a firm. While most papers in this literature (eg. Postel-Vinay and Robin, 2002; Cahuc et al., 2006; Bagger et al., 2014) model p as a firm-level parameter, it is natural for p to be position-specific when studying the executive labor market. The same manager's productivity as the CFO or CEO of a firm may be different, and our assumption reflects this.

Production and human capital. Let $t \geq 0$ denote a manager's *experience* and let τ such that $0 \leq \tau \leq t$ denote their *tenure* with their current firm. Each manager-position match involving a worker with experience t and tenure τ generates instantaneous log output,

$$y(p_j, t, \tau) = p_j + h(t, \tau), \tag{1}$$

$$h(t, \tau) = a + g(t) + k(\tau) + \varepsilon_t \tag{2}$$

where $p_j \in [p_{min}, p_{max}]$ is the position-specific match productivity parameter and $h(t, \tau)$ is the amount of human capital supplied by a manager of experience t and tenure τ.

A manager's human capital $h(t, \tau)$ is made up of four components. The parameter $a \sim N(0, \sigma_a^2)$ is a manager-specific skill parameter reflecting permanent differences in individual ability. The shock ε_t is zero-mean and worker-specific and reflects stochastic (instantaneous) changes in individual productivity over time, which we restrict to follow a first-order Markov process (Bagger et al., 2014).[2] The functions $g(t)$ and $k(\tau)$ are state-dependent deterministic trends reflecting general and firm-specific human capital accumulation on the job. A key focus of this paper will be analyzing the relative importance of g and k in managerial human capital, and their respective importance in wage growth, bargaining and mobility. The key distinction between the two: general human capital can transfer across firms, firm-specific cannot — when a manager enters unattachment or switches firms, the firm-specific component of their human capital is lost.

Another way of thinking about $k(\tau)$ is that the match-specific productivity $p_j + k(\tau)$ increases over tenure (Gao et al., 2021). As will be discussed later in this section, that match-specific productivity increases over tenure will influence mobility and on-the-job search over the executive's career.

When a manager is not working as an executive or CEO, we assume that they enter a state of *unattachment*, in which they have no ties to a firm and do not accumulate firm-specific human capital (i.e., τ remains at zero). However, we allow experience to accumulate while in unattachment. The nature of the data on executive wages and mobility necessarily limits us to analyzing publicly-listed firms. Given the nature of the executive labor market, it is likely that unattached executives are accumulating experience, for example by managing a private firm or working in consulting. Upon entering (observable) managerial employment, a manager's tenure immediately begins to accumulate so that $\tau \geq 0$.

[2]In our empirical specification, ε_t will be modeled as an AR1 Gaussian process.

Retirement, unattachment and job search. Employed and unattached managers retire and leave the market for good according to a Poisson process with instantaneous rate μ. Managers may also see their match terminated (and thus enter unattachment) according to rate η.

All managers engage in on-the-job search, but differing levels of seniority impact the types of offers they field. Executives can be considered for promotion to CEO at their current firm, which occurs according to arrival rate λ_0. Both executives and CEOs can receive a job offer to be the CEO at another firm (arrival rate λ_1).[3] Executives can also receive horizontal job offers to be executives at other firms (arrival rate λ_2). We make the assumption that CEOs cannot be demoted from their position of CEO.[4] Allowing internal and external promotion opportunities to arrive at different rates allows us to embed (exogenously) a preference for insiders, even if fully embedding this agency friction is outside the scope of this model.

When a manager sees their match dissolved, they enter a period of unattachment. Unattached managers exit the sample with probability μ. We specify separate parameters γ_E and γ_C which govern the executive and CEO job-finding rate (respectively) for unattached managers. These parameters arise out of the empirical pattern of managers becoming executives and CEOs after a period of unattachment.

Upon receiving a job offer, any manager (regardless of employment status or human capital) draws the position-specific productivity parameter associated with the offer; p_j is distributed according to the continuous and unconditional distribution $F(\cdot)$, which has support $[p_{min}, p_{max}]$. While it is not necessary for the model, we consider it natural that executive and CEO position-productivity can be drawn from different distributions, which we allow to occur in the estimation.

[3] We assume that the job finding rates for executives and CEOs are the same — λ_1 is the same for both executives and CEOs. While not necessary to estimate the model, this assumption simplifies the model solution. It is equivalent to saying that poaching firms put executives and CEOs in the same pool when considering candidates.

[4] This assumption is empirically founded. When examining potential demotions (when a manager is the CEO at a firm in year t and a non-CEO executive in year $t + 1$) in our data, we find that a large majority comprise advisory positions. For example, the previous CEO stays on at the firm explicitly as an advisor to the current CEO, or implicitly by taking chairmanship of the board. However, a small number of true demotions do exist in our data. Our model is not intended to study the decision to promote a (possibly interim) CEO and subsequently demote them, so we remove these managerial spells from our estimation sample.

2.2. Managerial Wage Contracts

Wages are modeled as piece-rate contracts — managers receive a share of the output they produce at the firm (Postel-Vinay and Robin, 2002; Cahuc et al., 2006; Bagger et al., 2014). If the piece rate $R = \exp(r) = 1$, then the manager captures the full surplus. Given the manager's human capital, log output is $y\left(p_j, t, \tau\right) = p_j + h(t, \tau)$. The manager's log wage is

$$w\left(p_j, t, \tau\right) = r_j + p_j + h(t, \tau) = r + p_j + k(\tau) + a + g(t) + \varepsilon_t$$

For an executive (CEO), with experience t, tenure τ at their current firm and position type p_j under a contract that stipulates $R = \exp(r)$, the value of being in that state is $V_i(r, h, \tau, p_i)$, for $i \in \{E, C\}$ (experience t is kept implicit in the state vector for convenience). The maximum value that a manager can extract from a match is $V_i(0, h, \tau, p)$.

A manager engages in continuous job search and incumbent and poaching firms potentially bargain over the manager's employment based on the information available at the end of each period. This bargaining occurs before any realizations of future shocks ε. Bargaining and on-the-job search in the model is microfounded as the outcome of an infinite-horizon game of alternating wage offers as in Rubinstein (1982): the outcome of the bargaining process will and largely follows the framework laid out in Cahuc et al. (2006) and Bagger et al. (2014), with a few twists. In particular, a manager's firm-specific human capital will impact the outcome of the bargaining game and on-the-job search. We first detail how human capital and on-the-job search impact CEO wages over their careers, and then complete the discussion by evaluating the same for executives. Appendix B details the bargaining process.

Over the following sections. we drop time subscripts from the notation, as human capital accumulates and job offers arrive continuously. Because firm-specific human capital deteriorates completely when managers switch firms (or enter unattachment), the worker's stock k (and their tenure τ) will reset to zero immediately. All other variables advance continuously according to the processes detailed above.

2.2.1. CEO Careers

A CEO contacts a possible new employer about an external CEO position of type p'_C according to Poisson arrival rate λ_1. The CEO, the poacher and the incumbent then enter into a three-player bargaining game of the type detailed in Cahuc et al. (2006). Relative to just bargaining with one employer, the situation is more favorable for the CEO as the poacher and incumbent must compete; the firm that values the CEO's services ultimately wins the bargains. The value of the match for the poacher and incumbent are p'_C and $p_C + k$.

Firm-specific human capital accumulation (k) means that the match quality of the firm and manager increases with tenure. For an outsider to win the bargain, the position-specific productivity must be $p'_C > \overline{\theta_C}$, which denotes the threshold position productivity for which the CEO would accept an outside offer. For these positions, the poaching firm will win the bargain by offering the contract r' which arises from the following rule:

$$\begin{aligned}\mathbb{E}\Big\{ V_C\big(r', h', 0, p'_C\big) \Big\} &= \mathbb{E}\left\{ V_C(0, h, k, p_C) + \beta_1 \Big[V_C(0, h, 0, p'_C) - V_C(0, h', k, p_C) \Big] \right\} \\ &= \mathbb{E}\left\{ (1-\beta_1) V_C(0, h, k, p_C) + \beta_1 V_C(0, h', 0, p'_C) \right\} \qquad (3)\end{aligned}$$

Eq. (3) can be interpreted as such — the dominant firm can attract the CEO by offering the expected value of the dominated position $p_C + k$ plus a share β_1 of the additional worker rents generated by the new match (Bagger et al., 2014). The exogenous parameter β_1 (to be estimated) represents, for example, managerial bargaining power in negotiations.

Of course, p'_C may be low enough such that the CEO does not accept the poaching offer; it may be low enough that the CEO simply discards the offer. For the range $p'_C \in \big(\underline{\theta_C}, \overline{\theta_C}\big]$, the poaching firm induces the incumbent to offer the CEO a new contract to retain their services. The lower bound of this range, which we label $\underline{\theta_C}$, represents the threshold position-type for which the CEO could extract the full surplus from the match. For this type of offer, the CEO's contract is updated according to the following rule:

$$\mathbb{E}\Big\{ V_C\big(r', h, k, p_C\big) \Big\} = \mathbb{E}\left\{ (1-\beta_1)V_C(0, h', 0, p_C') + \beta_1 V_C(0, h, k, p_C) \right\} \tag{4}$$

and the CEO stays in their current position, with an updated contract due to the competition between the incumbent and poacher. The upper bound position $\overline{\theta_C}$ is the offer for which the CEO is indifferent between taking the poaching offer and the updated contract with the incumbent:

$$\mathbb{E}\Big\{ V_C\big(r'\big(\overline{\theta_C}\big), h', 0, \overline{\theta_C}\big) \Big\} = \mathbb{E}\Big\{ V_C\big(r'(p_C), h, k, p_C\big) \Big\}$$

Simple algebra reveals that $\overline{\theta_C}$ is determined by

$$\mathbb{E}\Big\{ V_C\big(0, h', 0, \overline{\theta_C}\big) \Big\} = \mathbb{E}\{V_C(0, h, k, p_C)\} \tag{5}$$

The lower bound $\underline{\theta_C}$ arises out of the indifference condition (the position-type which would have no impact on the CEO's contract):

$$\mathbb{E}\{V_C(r, h, k, p_C)\} = \mathbb{E}\left\{ (1-\beta_1)V_C(0, h', 0, \underline{\theta_C}) + \beta_1 V_C(0, h, k, p_C) \right\} \tag{6}$$

If the position-type $p_C' < \underline{\theta_C}$, the CEO discards the offer. Eq. (6) dictates how on-the-job search impacts the CEO's contract over time. If the CEO receives an offer of a position type within the range $\big(\underline{\theta_C}, \overline{\theta_C}\big]$, on-the-job search will induce an upward revision in the CEO's piece rate.

2.2.2. Non-CEO Executive Careers

On-the-job search for executives is similar to that of CEOs, however they have a larger set of possible outcomes at any given time. An executive can be promoted to CEO at their current firm, accept a CEO position at another, or move horizontally to be executive at another firm.

Internal promotion. Consider an employed executive with match productivity p_E. When approached employer and evaluated for promotion to CEO, we assume that the CEO-specific match productivity p'_C is drawn from the distribution $F(p)$. There is no guarantee that an executive positional productivity will transfer in promotion to CEO, and this assumption reflects this.

Considerations for internal promotion to CEO arrive according to rate λ_0. The sharing rule for promotions implies that the critical level of CEO position productivity for which the executive would accept the position is determined by $V_C(0, h, k, \overline{\theta_0}) = V_E(r, h, k, p_E)$. For positions above this threshold, the rule governing the contract the executive receives under a successful CEO promotion arises out of the following equation:

$$\mathbb{E}\Big\{ V_C(r', h, k, p' \Big\} = \mathbb{E}\left\{(1-\beta_0)V_E(r, h, k, p) + \beta_0 V_C(0, h, k\cdot p')\right\} \tag{7}$$

Note that the sharing rule from (7) is different to that stemming from bargaining between a manager, poacher and incumbent firm because promotion is a two-player game — the executive and the firm bargain, and the executive's threat point is their current contract $\mathbb{E}\{V_E(r, h, k, p_E)\}$.[5] For successful promotions, the firm offers the executive the value of their current position along with a share β_0 of the additional rent to the worker brought about by being promoted to CEO. The exogenous parameter β_0 (to be estimated) captures the wage premium paid to the manager when promoted to CEO. We estimate β_0 and β_1 (bargaining power in inside and outside wage negotiations, respectively) as different parameters.

A key point to note is that firm-specific human capital remains when executives are promoted to CEO. This also means that (7) is effectively independent of firm-specific human capital k (it appears equivalently on both sides), in contrast to the sharing rules for external hiring.

[5]Eq. (7) resembles bargaining between unemployed workers and firms as in Cahuc et al. (2006). In their setting, a firm is able to employ an unemployed worker if the match is productive enough to compensate the worker for their forgone unemployment income. In our setting, executives are promoted to CEO if the CEO-match is productive enough to replace the productivity of the executive in their current position.

External CEO poaching. Considerations for external promotion to CEO arrive according to λ_1.[6] Like with the CEO, there exists an upper threshold for which the executive will accept the outside CEO position over their current executive position, $\overline{\theta_1}$. For all position-types $p'_C > \overline{\theta_1}$, the poacher will be dominant and can win the executive's services by offering the contract:

$$\mathbb{E}\left\{ V_C\left(r', h', 0, p'_C\right) \right\} = \mathbb{E}\left\{ (1-\beta_1)V_E(0, h, k, p_E) + \beta_1 V_C(0, h', 0, p'_C) \right\} \tag{8}$$

For $p' \in \left(\underline{\theta_1}, \overline{\theta_1}\right]$, the incumbent can retain the executive by offering the contract:

$$\mathbb{E}\left\{ V_E\left(r', h, k, p\right) \right\} = \mathbb{E}\left\{ (1-\beta_1)V_C(0, h', 0, p') + \beta_1 V_E(0, h, k, p) \right\} \tag{9}$$

Similarly to the CEO, the threshold range which determines how on-the-job search impacts CEO wages over the career, $\left(\underline{\theta_1}, \overline{\theta_1}\right]$, is determined by the position $\overline{\theta_1}$ which equates (8) and (9):

$$\mathbb{E}\left\{ V_C\left(0, h', 0, \overline{\theta_1}\right) \right\} = V_E(0, h', k', p) \tag{10}$$

The lower bound type for which the executive would capture the full surplus is given by

$$\mathbb{E}\{V_E(r, h, k, p_E)\} = \mathbb{E}\left\{ (1-\beta_1)V_C(0, h', 0, \underline{\theta_1}) + \beta_1 V_E(0, h, k, p_E) \right\} \tag{11}$$

Within the range $\left(\underline{\theta_1}, \overline{\theta_1}\right]$, job offers will cause upward revisions in the piece rate determining the CEO's contract.

External horizontal poaching. Executives can also receive job offers to be executives at other firms and these offers arrive according to λ_2. The search thresholds $\left\{\underline{\theta_2}, \overline{\theta_2}\right\}$ determine job

[6] Though executives and CEOs likely receive CEO position offers at different rates, for simplicity we assume that λ_1 is the general probability of receiving an external CEO offer.

switches and piece-rate revisions, respectively:

$$\mathbb{E}\Big\{ V_E\big(0, h', 0, \overline{\theta_2}\big) \Big\} = \mathbb{E}\{V_E(0, h, k, p_E)\} \tag{12}$$

$$\mathbb{E}\{V_E(r, h, k, p_E)\} = \mathbb{E}\left\{ (1-\beta_1)V_E(0, h', 0, \underline{\theta_2}) + \beta_1 V_E(0, h, k, p_E) \right\} \tag{13}$$

2.2.3. Unattached Managers

When unattached, managers can receive an executive or CEO job offer (with rates γ_E and γ_C). We assume throughout the paper that the value of being unattached is equivalent to employment in the least-productive executive position, $V_U(h) = \mathbb{E}\{V(0, h', 0, p_{min}\}$. As in Bagger et al. (2014), this convenient assumption means that the unattached manager accepts any job offer.

2.3. Value Functions

We assume that managers have logarithmic flow utility and that there is no transfer of wealth across time. The discount rate is ρ. A manager's state is (r, h, k, p): their current piece rate, their human capital, their firm-specific capital and their firm's type (with tenure t kept implicit). Let $S(\cdot) = 1 - F(\cdot)$ be the survivor function for the distribution of position types. Given the threshold position $\underline{\theta}$ which leads to no contract revision, $S(\underline{\theta})$ represents the fraction of positions for which the manager simply discards the job offer.

CEOs have the value function:

$$\begin{aligned}\big(\rho + \mu + \eta + \lambda_1 S\big(\underline{\theta_C}\big)\big) V_C(r, h, k, p) = \; & w + \eta V_U(h) + \\ & \lambda_1 \int_{\overline{\theta_C}}^{p_{max}} \mathbb{E}\Big\{ (1-\beta_1)V_C(0, h, k, p) + \beta_1 V_C(0, h', 0, x) \Big\}\, dF(x) + \\ & \lambda_1 \int_{\underline{\theta_C}}^{\overline{\theta_C}} \mathbb{E}\Big\{ (1-\beta_1)V_C(0, h', 0, x) + \beta_1 V_C(0, h, k, p) \Big\}\, dF(x)\end{aligned} \tag{14}$$

The CEO's value is the sum of their current flow utility w and the instantaneous value of the current state plus the value of all other possible states appropriately discounted. The CEO can enter unattachment (rate η), which has value $V_U(h)$. They receive outside job offers (rate λ_1) from the productivity distribution $F(x)$. Given the job offer they receive, three outcomes may happen. If $x > \overline{\theta_C}$, the CEO takes the new CEO position, which results in value according to (3). If $x \in \left(\underline{\theta_C}, \overline{\theta_C}\right]$, the CEO remains in their current position with a revised contract, dictated by the rule in (4). If $x < \underline{\theta_C}$, the CEO discards the job offer. Lastly, the CEO can retire (rate μ), which has a value of 0. With complementary rate $1 - \mu - \eta - \lambda_1 S\left(\underline{\theta_C}\right)$, nothing happens and the CEO remains in their current position, with no revision to the contract.

Executives have a similar, if slightly more cumbersome, value function V_E:

$$
\begin{aligned}
\left(\rho + \mu + \eta + \sum_{s=0}^{2} \lambda_s S\left(\underline{\theta_s}\right)\right) V_E(r,h,k,p) = \;& w + \eta V_U(h) + \\
& \lambda_0 \int_{\overline{\theta_0}}^{p_{max}} \mathbb{E}\left\{(1-\beta_0)V_E(0,h,k,p) + \beta_0 V_C(0,h,k,x)\right\} dF(x) + \\
& \lambda_1 \int_{\overline{\theta_1}}^{p_{max}} \mathbb{E}\left\{(1-\beta_1)V_E(0,h',k',p) + \beta_1 V_C(0,h',0,x)\right\} dF(x) + \\
& \lambda_1 \int_{\underline{\theta_1}}^{\overline{\theta_1}} \mathbb{E}\left\{(1-\beta_1)V_C(0,h',0,x) + \beta_1 V_E(0,h',k',p)\right\} dF(x) + \\
& \lambda_2 \int_{\overline{\theta_2}}^{p_{max}} \mathbb{E}\left\{(1-\beta_1)V_E(0,h',k',p) + \beta_1 V_E(0,h',0,x)\right\} dF(x) + \\
& \lambda_2 \int_{\underline{\theta_2}}^{\overline{\theta_2}} \mathbb{E}\left\{(1-\beta_1)V_E(0,h',0,x) + \beta_1 V_E(0,h',k',p)\right\} dF(x)
\end{aligned}
\tag{15}
$$

2.4. On-the-Job Search, Human Capital and the Executive Wage Process

This section outlines how human capital and on-the-job search impact managerial wages over their careers. We pay particular attention to the interaction between the two — how does (firm-specific) human capital impact mobility and bargaining over a manager's career?

2.4.1. CEO Position Thresholds and Contractual Piece Rate

The upper threshold $\overline{\theta_C}$, which is the minimum productivity position for which a CEO would accept an external position, is given by

$$\overline{\theta_C} = p_C + k \tag{16}$$

The lower threshold, for which an outside offer leads to no revision in the CEO's contract, is determined by the solution to the following equation

$$r = -(1-\beta_1)\int_{\underline{\theta_C}}^{\overline{\theta_C}} q(x)\,dx \tag{17}$$

where

$$q(x) = \frac{\rho + \mu + \eta + \lambda_1 S\Big(x\Big)}{\rho + \mu + \eta + \lambda_1 \beta_1 S\Big(x\Big)}$$

These thresholds resemble those derived in Bagger et al. (2014) with the added impact of firm-specific human capital. To understand this impact, it is useful to break the CEO's piece-rate into two parts and discuss how these bargaining thresholds adjust over a CEO's tenure,

$$r = -(1-\beta_1)\Bigg(\underbrace{\int_{\underline{\theta_C}}^{p_C} q(x)\,dx}_{\text{Option value of renogotiation}} + \underbrace{\int_{p_C}^{p_C+k} q(x)\,dx}_{\text{Job lock effect}} \Bigg)$$

By inspection, the range $\left(\underline{\theta_C}, \overline{\theta_C}\right]$ becomes wider over tenure, as the contractual piece rate remains constant without revision to the CEO's contract through job search. Conditional on the CEO remaining in the current contract, two countervailing effects impact the CEO's on-the-job search. First, the more firm-specific human capital the CEO has, the less likely they are to receive an outside CEO offer that will poach them away. This “job lock effect" endogenously decreases the value the CEO derives from job-hopping (potential outside offers) as they become more tenured.

Second, to compensate the CEO for the lost value from job-hopping (by keeping the piece rate constant), the CEO has an option value derived from renegotiation. To compensate for the increased threshold for which the CEO would job-hop ($\overline{\theta_C}$), the renegotiation threshold $\underline{\theta_C}$ adjusts downwards. That is, the value the CEO derives from fielding outside job offers which improve his current contract firm increases over tenure.

The key driver of these effects is firm-specific human capital. That the match-specific productivity increases over tenure has implications for CEO wage growth and mobility over CEO careers.

2.5. Executive Position Thresholds and Contractual Piece Rate

Executives can experience three job-transition events (excluding unattachment and retirement). The value of promotions is pinned to the productivity threshold $\overline{\theta_0}$, is the minimum position-productivity the executive would accept promotion (which we solve for below). To be poached away for an external CEO position, the executive must receive at least an offer with productivity $\overline{\theta_0} + k$. That is, the competing position must have at least the productivity of the internal promotion position and the value of the executives firm-specific human capital.[7] The value of horizontal transitions (executive positions at other firms) is determined by a similar set of equations as (17) and (16), and importantly $\overline{\theta_2} = p + k$ as above.

The value of internal promotion is determined by the endogenous productivity threshold $\overline{\theta_0}(p)$ for which the executive would accept promotion to CEO at their current firm. As we show in Appendix A, $\overline{\theta_0}(p)$ arises out of the solution to the differential equation

$$\begin{aligned} \frac{\partial \overline{\theta_0}(p)}{\partial p}(0,h,k,p) &= \frac{\frac{\partial V_E}{\partial p}(0,h,k,p)}{\frac{\partial V_C}{\partial p}(0,h,k,\overline{\theta_0}(p))} = \frac{\phi_E(p+k)}{\phi_C(\overline{\theta_0}(p)+k)} \\ &= \frac{\rho+\mu+\eta+\lambda_1\beta_1 S(\overline{\theta_0}+k)}{\rho+\mu+\eta+\lambda_0\beta_0 S(\overline{\theta_0})+\lambda_1\beta_1 S(\overline{\theta_0}+k)+\lambda_2\beta_1 S(p+k)} \end{aligned} \tag{18}$$

where $\phi_E(x)$ and $\phi_C(x)$ are the derivatives of the executive and CEO value functions with respect to position productivity when the manager has captured the full surplus.

[7] This follows because $V_E(0,h,k,p_E) = V_C(0,h,k,\overline{\theta_0})$ via internal promotion. Then, external promotion threshold $\overline{\theta_1}$ is determined by $V_C(0,h,k,\overline{\theta_1}) = V_E(0,h,k,p_E) = V_C(0,h,k,\overline{\theta_0})$.

The lower thresholds $\underline{\theta_1}$ and $\underline{\theta_2}$, which determine the renogotation ranges are derived from the sharing rules in Section 2.2.2 and displayed in the appendix. The key intuitions remain, however. Namely that, as firm-specific human capital accumulates, executives experience a job-lock effect and a renegotiation option effect which counteract against each other in determining wage growth and mobility along an executive's career.

2.5.1. The managerial wage process

This gives the model's empirical wage processes for managers (for $j \in \{E, C\}$)

$$w_j(p_j, t, \tau) = \alpha + \varepsilon(t) + g(t) + k(\tau) + p_j + r_j\big(p_j, k(\tau), \theta_j(p_j, k(\tau))\big) \tag{19}$$

where $\theta_j(p_j, k(\tau))$ tracks the reservation option for the manager — the last position for which the manager has captured the full surplus from the match.

We can use (19) to write the model's wage growth process over the executive's career, which allows us to decompose wage growth into its various pieces. First, consider CEOs who do not enter a state of unattachment and denote p'_C as the (potential) draw for a new position from search. $\underline{\theta_C}'$ tracks the (possibly updated) threshold position productivity for which the CEO captures the full surplus. The CEO-wage growth process (in expectation) is

$$\begin{aligned} dw_C(p_C, t, \tau) = {} & \underbrace{dg(t)}_{\text{General human capital accumulation}} + \\ & \underbrace{[1 - \mu - \eta - \lambda_1 S(p_C + k(\tau))] \times dk(\tau)}_{\text{Firm-specific human capital accumulation}} + \\ & \underbrace{\lambda_1 \big[S(\underline{\theta_C}) - S(p_C + k(\tau))\big] \times \left(r_C\big(p_C, k(\tau), \underline{\theta_C}'\big) - r_C\big(p_C, k(\tau), \underline{\theta_C}\big) \right)}_{\text{Contract renegotiation}} + \end{aligned}$$

$$\underbrace{\lambda_1 S(p_C + k(\tau)) \times \left(p_C' - (p_C + k(\tau)) + r_C\big(p_C, 0, \underline{\theta_C}'\big) - r_C(p_C, k(\tau), \underline{\theta_C}) \right)}_{\text{Job-hopping}} \quad (20)$$

Eq. 20 is the key equation of the paper. The first line tells us the impact of general human capital accumulation on wage growth, the portion of human capital that stays with the CEO across their career. The second line tracks firm-specific human capital accumulation (note that firm-specific human capital will accumulate in all states when the CEO does not switch firms). The third line tracks the impact of job-hopping: CEOs taking up other CEO positions over their career (where we incorporate the loss of firm-specific capital in this event). The last line tracks the impact of on-the-job search on CEO wages over their career — job offers that lead to contract renegotiation, but ultimately do not induce the CEO to switch firms.

The empirical value of this equation is apparent. The relative importance of the components of human capital is largely unobservable in the data. Further, any impact of search on contract renegotiation is also unobservable to the researcher. A key focus of our estimation will be an empirical analysis of (20).

3. Estimation

We estimate the model via indirect inference (Smith, 2016).[8] Appendix C details the estimation algorithm and the majority of this section is devoted to our identification strategy.

3.1. Identification Strategy

We show there is a tight relation between the reduced-form outcomes of the auxiliary model and structural parameters, which is key to the success of the indirect inference approach. We have four sets of "moments" which target different sets of structural parameters, and our identification

[8] Indirect inference is a simulated method of moments estimator which involves fitting an auxiliary model that incorporates parameters from (potentially misspecified) reduced-form econometric models. This approach entails comparing the parameters of the auxiliary model fitted on both observed and simulated data to find the vector of structural parameters that minimizes the distance between them. Indirect inferences generates consistent estimates of the economic model by mapping the parameters of the structural (economic) model to the parameters of the auxiliary model.

argument is inspired by key papers in the structural search and human capital literature (e.g., Cahuc et al., 2006; Bagger et al., 2014)

3.1.1. Executive Labor Market Mobility

The model entails three types of (un)employment: unattachment, executive employment and CEO employment. We allow all conditional transition probabilities (from employment to unattachment) to vary by tenure. In particular, we condition on managers in the first five years of tenure at their current firm (or later) when calculating the empirical moments that identify labor market mobility, which is empirically motivated.

Managers retire/die at rate μ_τ for any employment type. In the data, if a manager transitions out of their current position and does not appear in the data again, we assume retirement. The parameters μ_τ is identified by the the empirical probabilities that an employed manager (executive or CEO) enters retirement (conditional on tenure). The parameters η_τ is identified by the same for employed managers entering unattachment. We replenish the economy with new unattached managers (experience and tenure of 0) to match the unconditional retirement rate μ

Unattached managers can become an executive, a CEO or stay unattached. The rates γ_E and γ_C capture the likelihood of these events. These are identified by the empirical probabilities of an unattached manager entering executive or CEO employment from unattachment.

Executives (i.e., non-CEOs) can experience 3 mobility events at any given point (excluding entering unattachment or retirement). They can be promoted to CEO at their current firm ($\lambda_0(\tau)$), become CEO at another firm ($\lambda_1(\tau)$), move horizontally ($\lambda_2(\tau)$). These are identified by the early- and later-tenure empirical probabilities of these events happening to executives. Similarly for CEOs, they can only experience one mobility event: $\lambda_1(\tau)$. Thus, the parameter $\lambda_1(\tau)$ is identified by both the executive and CEO probability of leaving their firm to be CEO at another.

3.1.2. Mincer Wage Regressions

For the full sample of managers in executive or CEO employment, we estimate a Mincer wage equation. That is we run the regression, for firm i, position j (non-CEO vs CEO), executive s and year t

$$w_{ijst} = \sum_{q=1}^{Q} \left(a_q \tau_{ist}^q + b_q t_{st}^q \right) + \gamma_{ij} + \phi_s + u_{ijst} \tag{21}$$

The tenure and experience polynomials are useful for identifying the $g(t)$ and $k(\tau)$ functions and variation in wages across resets of tenure within executive careers (holding experience fixed) are especially useful for separating out firm-specific human capital.

The position (CEO vs. non-CEO) × firm fixed effect γ_{ij} helps identify the position productivity distributions. As in Bagger et al. (2014), we assume a Weibull distribution for productivity in the model, which requires a support $[p_{min}, p_{max}]$, a scale and a shape parameter, where $F_j(p) = 1 - \exp\left(-[s_{j1}(p - p_{min}]^{s_{j2}}\right)$. We winsorize γ_{ij} at the 0.5 percentile and include in the auxiliary model the 0.5 and 99.5 percentiles, and the first four moments of the distribution, by position. The volatilities of the manager-specific fixed effect and the residual help pin down variation in managerial ability and the human capital idiosyncratic shock. To help pin down the AR1 coefficient in the human capital shock, we include as a moment the autocorrelation in u_{ijt} for executives with at least eight years of consecutive experience.

Wage Changes After Mobility Events. To help pin down the bargaining power parameters, we include as moments the average change in executive wages when (i) executives are promoted to CEO (β_0), (ii) managers take up CEO positions at other firms (β_1), (iii) executives take up horizontal positions at other firms (β_2) and (iv) they remain in their current position. We compute these moments after residualizing out the tenure and experience polynomials from the wage regressions.

3.1.3. Within- and Across-Job Wage Growth

We also consider how experience and tenure separately impact wage growth of executive careers. Specifically, we estimate a general wage growth specification, for manager s in year t

$$\Delta w_{st} = w_0 + \sum_{q=2}^{Q} \left(w_{t,q} \Delta t_{st}^{q} + w_{\tau,q} \Delta \tau_{st}^{q} \right) + \Delta u_{st} \tag{22}$$

We condition only that a manager have two consecutive years of experience to be included in this regression.

We also limit the sample and run an event study when executives change firms. That is, in a 3-year window around the event (so, a maximum of seven years of data per manager, and a minimum of two years experience at either firm in the years before and after the switch), we estimate, for firm × position j, manager s and year t

$$\Delta w_{jst} = \omega_0 + \sum_{q=2}^{Q} \omega_{t,q} \left(\Delta t_{st}^{q} + \omega_{\tau,q} \Delta \tau_{jst}^{q} \right) + \gamma_j + \Delta \nu_{st} \tag{23}$$

The slope coefficients in (22) and (23) are most useful for identifying $g(\cdot)$ and $k(\cdot)$. For example, in (23), we use variation in the change in wages across the tenure that the CEO made the switch to identify how losses in firm-specific capital impact wages. Controlling for position × firm fixed effects, nets out the impact of the change in position.

We also include the volatility, skewness and kurtosis of the residuals and the first- through fourth-order residual autocovariances to help further separate the human capital shock from the human capital accumulation functions in these two regressions. We also include the first four moments of the position fixed effect.

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A. Proofs

This section is largely devoted to deriving the productivity thresholds which determine job-search outcomes over executive and CEO careers. These arise out of the bargaining conditions detailed in Sections 2.2.1 and 2.2.2. To do so, we first derive a simplified version of the value function for CEOs and executives, respectively. Then, we derive the upper and lower productivity thresholds which determine job-hopping and contract renegotiation.

A.1. Uncovering the CEO's Bargaining Thresholds

A.1.1. Value Function Derivation for the CEO

We derive a simplified version of (14) for the estimation. Denote

$$\phi_C(x) = \frac{\partial V_C}{\partial x}(0, h, 0, x)$$

as the partial derivative of the CEO's value function (when they have captured the full surplus) with respect to p.

Start by simplifying (14) via integration by parts,

$$\begin{aligned}(\rho + \mu + \eta)V_C(r, ghk, p) = \; & w + \eta V_U(g) + \\ & \lambda_1\beta_1 \int_{\overline{\theta_C}}^{p_{max}} \phi_C(x)S(x)\, dx + \\ & \lambda_1(1-\beta_1) \int_{\underline{\theta_C}}^{\overline{\theta_C}} \phi_C(x)S(x)\, dx\end{aligned}$$

This simplification follows from the transferability of position productivity p and firm-specific human capital k. That is, the value of being in a $p+k$ position with no human capital is equivalent to being in a p position with k units of human capital. If $r_C = 0$ then $\underline{\theta_C} = p + k$ as the CEO captures the full surplus produced by the match between the CEO and the firm. We have

$$(\rho + \mu + \eta)V_C(r, h, k, p) = \; w + \eta V_U(g) +$$

$$\lambda_1\beta_1 \int_{\overline{\theta_C}}^{p_{max}} \phi_C(x)S(x)\ dx$$

Differentiating with respect to $x = p + k$ (using Leibniz' rule) gives:

$$\phi_C(x) = \frac{1}{\rho + \mu + \eta + \lambda_1\beta_1 S(x)}$$

We can then write $V_C(r, g, k, p)$ as

$$\begin{aligned}(\rho + \mu + \eta)V_C(r, h, k, p) = \ & w \ + \ \eta V_U(g) + \\ & \lambda_1\beta_1 \int_{\overline{\theta_C}}^{p_{max}} \phi_C(x)S(x)\ dx + \\ & \lambda_1(1 - \beta_1) \int_{\underline{\theta_C}}^{\overline{\theta_C}} \phi_C(x)S(x)\ dx \end{aligned} \tag{A.1}$$

A.1.2. Productivity thresholds derivation for the CEO

By inspection, the threshold in (5) and (A.1) reveals that

$$\overline{\theta_C} = p + k$$

By the threshold condition in (6), we have

$$\mathbb{E}\Bigg\{ V_C(r, h, k, p) \Bigg\} = \mathbb{E}\Bigg\{ (1 - \beta_1)V_C(0, g, 0, \theta_C) + \beta_1 V_C(0, h, k, p) \Bigg\}$$

Note that

$$\begin{aligned}\mathbb{E}\Bigg\{ V_C(r, h, k, p) - \beta_1 V_C(0, h, k, p) \Bigg\} = \ & r + (1 - \beta_1)(a + p + g + k + \varepsilon) \\ & + \ \lambda_1\beta_1(1 - \beta_1) \int_{p+k}^{p_{max}} \phi_C(x)S(x)\ dx\end{aligned}$$

and

$$
\begin{aligned}
(1-\beta_1)\mathbb{E}\left\{ V_C(0,h,0,\theta_C) \right\} = \; & (1-\beta_1)(a+h'+\underline{\theta_C}+\varepsilon) \\
& + \lambda_1\beta_1(1-\beta_1)\int_{p+k}^{p_{max}} \phi_C(x)S(x)\,dx \\
& + \lambda_1(1-\beta_1)^2\int_{\underline{\theta_C}}^{p+k} \phi_C(x)S(x)\,dx
\end{aligned}
$$

Combining the two with the threshold condition gives

$$
r = -(1-\beta_1)\left((p+k-\underline{\theta_C}) - \lambda_1(1-\beta_1)\int_{\underline{\theta_C}}^{p+k} \frac{S(x)}{\rho+\mu+\eta+\lambda_1\beta_1 S(x)}\,dx \right)
$$

Which can be rewritten as

$$
r_C = -\int_{\underline{\theta_C}(r,h,k,p)}^{p+k} q(x)\,dx \tag{A.2}
$$

where

$$
q(x) = \frac{\rho+\mu+\eta+\lambda_1 S(x)}{\rho+\mu+\eta+\lambda_1\beta_1 S(x)}
$$

This implicitly defines $\theta_C(r,h,k,p)$. Note that neither the piece rate nor the CEO's outside option $\underline{\theta_C}$ are functions of the CEO's general human capital, but are both impacted by firm-specific capital, as firm-specific capital improves the match-specific productivity across tenure.

A.1.3. Evolution of piece rates, position types and thresholds for the CEO

We can derive the evolution of piece rates, firm types and thresholds over the CEO's career. For a CEO that starts their tenure at a firm of type p with $\tau = 1$, coming from unattachment, we have

$$
(r_C, p_C, \theta_C) = (r_C^0, p, p_{min})
$$

where $r_C^0 = -\int_{p_{min}}^{p} q(x)\,d(x)$. The assumption here being that the threshold type of being unattached is equivalent to the minimum firm's productivity. This happens with density $\gamma_C f(p)$ Otherwise, given $(r_C, p, \underline{\theta_C}, \overline{\theta_C})$, we have

$$
\left(r_C', p', \underline{\theta_C}', \overline{\theta_C}'\right) =
\begin{cases}
(\cdot,\cdot,\cdot,\cdot) & \text{at rate } \mu+\eta \\
(s(\phi), p, \phi, p+k), \quad \forall\, \phi \in (\underline{\theta_C}, p+k] & \text{at rate } \lambda_1 f(\phi) \text{, where } s(\phi) = -\int_{\phi}^{p+k} q(x)\, dx \\
(s(\psi), \psi, p+k, \psi), \quad \forall\, \psi > p+k' & \text{at rate } \lambda_1 f(\psi) \text{, where } s(\psi) = -\int_{p+k}^{\psi} q(x)\, dx \\
(r_C, p, \overline{\vartheta_C}, p+k) & \text{at rate } 1-\mu-\eta-\lambda_1 S(\overline{\vartheta_C}) \text{, where } \overline{\vartheta_C} \text{ solves (A.2)}
\end{cases}
$$

A.2. Uncovering the Executive's Bargaining Thresholds

A.2.1. Value function derivation for the executive

The value function for the executive is given by:

$$
\begin{aligned}
(\rho+\mu+\eta)V_E(r,h,k,p) = r + g + k + p + \eta V_U(h) + \lambda_0\beta_0 \int_{\overline{\theta_0}}^{p_{max}} \phi_C(x)S(x)dx \;+ \\
\lambda_1\beta_1 \int_{\overline{\theta_0}+k}^{p_{max}} \phi_C(x)S(x)dx + \lambda_1(1-\beta_1)\int_{\underline{\theta_1}}^{\overline{\theta_1}} \phi_C(x)S(x)dx \;+ \\
\lambda_2\beta_1 \int_{\overline{\theta_2}}^{p_{max}} \phi_E(x)S(x)dx + \lambda_2(1-\beta_1)\int_{\underline{\theta_2}}^{\overline{\theta_2}} \phi_E(x)S(x)dx
\end{aligned}
\tag{A.3}
$$

By inspection and the bargaining rules in Section 2.2.2, it follows that $\overline{\theta_1} = \overline{\theta_0} + k$. It also follows that $\overline{\theta_2} = p+k$. Thus, deriving $\overline{\theta_0}$ reveals all of the upper productivity thresholds for the executive.

Setting $r = 0$ and differentiating with respect to $p + k$ yields:

$$
\phi_E(p+k) = \frac{\partial V_E}{\partial p}(0,h,k,p) = \frac{1 - \phi_C(\overline{\theta_0}+k)\frac{\partial \overline{\theta_0}}{\partial p}\left(\lambda_0\beta_0 S(\overline{\theta_0}) + \lambda_1\beta_1 S(\overline{\theta_0}+k)\right)}{\rho+\mu+\eta+\lambda_2\beta_1 S(p+k)}
\tag{A.4}
$$

Taking the definition of $\overline{\theta_0}(p)$, $V_C(0,h,k,\overline{\theta_0}(p)) = V_E(r,h,k,p)$, and differentiating both sides yields:

$$\frac{\partial \overline{\theta_0}}{\partial p}(r,h,k,p) = \frac{\frac{\partial V_E}{\partial p}(r,h,k,p)}{\frac{\partial V_C}{\partial p}(0,g,k,\overline{\theta_0}(0,h,k,p))} \tag{A.5}$$

Inserting (A.5) into (A.4) and evaluating at $r = 0$ yields:

$$\phi_E(p+k) = \frac{1}{\rho + \mu + \eta + \lambda_2\beta_1 S(p+k) + \lambda_1\beta_1 S(\overline{\theta_0}+k) + \lambda_0\beta_0 S(\overline{\theta_0})} \tag{A.6}$$

which completes the description of the executive's value function.

A.2.2. Productivity thresholds derivation for the executive

First, the position productivity threshold for promotion comes as the solution to the differential equation

$$\frac{\partial \overline{\theta_0}}{\partial p}(r,h,k,p) = \frac{\phi_E(p+k)}{\phi_C(\theta_0(p)+k)} \tag{A.7}$$

As derived above, we have $\overline{\theta_1} = \overline{\theta_0} + k$ and $\overline{\theta_2} = p + k$. The lower renegotiation thresholds then arise because they are the minimum productivity, be it horizontal executive or external promotion, which the executive captures the full surplus, i.e. which balances the thresholds conditions in (11) and (13).

B. Microfoundation of Bargaining Rules

Derivation of sharing rule for internal promotions. Suppose an executive is approached by their firm and evaluated for a promotion to CEO. First, a new match productivity parameter p' is drawn, summarizing the executive's fitness for the CEO position. Each party makes alternating offers over the piece rate r'. If the offer is accepted, the bargaining game ends. If the offer is rejected, some time elapses before a counteroffer is made. Let Δ_e and Δ_f respectively denote the lengths of time which elapse following a rejection by the executive and firm. It is also assumed that during negotiations, the match severs at rate η in which case the executive remains in their current position, and additional offers for outside CEO and non-CEO positions respectively arrive at rates λ_1 and λ_2. The subgame perfect equilibrium of this game consists of piece rate offers

(r_e, r_f) which make the other party indifferent between immediate acceptance and waiting to make a counteroffer. That is, r_e and r_f respectively solve:

$$V_C(r_f,h,\tau,p') = \frac{1}{1+\rho\Delta_e}\Bigg[w_t\Delta_e + \eta\Delta_e V_E(r,h,\tau,p) + \lambda_1\Delta_e\tilde{V}_C(\cdot) + \lambda_2\Delta_e\tilde{V}_E(\cdot)$$
$$+ (1-\Delta_e(\eta+\lambda_1+\lambda_2))V_C(r_e,h,\tau,p')\Bigg] \tag{B.1}$$
$$\Pi_C(r_e,h,\tau,p') = \frac{1}{1+\rho\Delta_f}\Bigg[\pi_0\Delta_e + \eta\Delta_e\Pi_0 + \lambda_0\Delta_f\tilde{\Pi}_C(\cdot) + \lambda_1\Delta_f\tilde{\Pi}_C(\cdot)$$
$$+ (1-\Delta_f(\eta+\lambda_0+\lambda_1))\Pi_C(r_f,h,\tau,p')\Bigg] \tag{B.2}$$

$\Pi_C(x)$ denotes the value to the firm of filling the CEO position given state x. π_0 and Π_0 denote the flow and net present values to the firm of having a vacant CEO position, both of which we assume to equal 0. $\tilde{V}_C$ and $\tilde{V}_E$ denote the executive's net present value of initiating a new bargaining game for a CEO or non-CEO position upon the arrival of a competing offer. Similar for $\tilde{\Pi}_C$. The two equations above can be rewritten as:

$$V_C(r_f,h,\tau,p') - V_C(r_e,h,\tau,p') = -\Delta_e\Bigg[(\eta+\lambda_1+\lambda_2)V_C(r_e,h,\tau,p') + \rho V_C(r_f,h,\tau,p')$$
$$- w_t - \eta V_E(r,h,\tau,p) - \lambda_1\tilde{V}_C(\cdot) - \lambda_2\tilde{V}_E(\cdot)\Bigg] \tag{B.3}$$
$$\Pi_C(r_e,h,\tau,p') - \Pi_C(r_f,h,\tau,p') = -\Delta_f\Bigg[(\eta+\lambda_0+\lambda_1)\Pi_C(r_f,h,\tau,p') + \rho\Pi_C(r_e,h,\tau,p')$$
$$- \pi_0 - \eta\Pi_0 - \lambda_0\tilde{\Pi}_C(\cdot) - \lambda_1\tilde{\Pi}_E(\cdot)\Bigg] \tag{B.4}$$

The above conditions imply that $r_f \to r_e$ as $\Delta_f, \Delta_e \to 0$. Denote their common limit by r' and define:

$$\frac{\partial V_C}{\partial r}(r,h,\tau,p') = \lim_{\Delta_f,\Delta_e\to 0}\frac{V_C(r_f,h,\tau,p') - V_C(r_e,h,\tau,p')}{r_f - r_e} \tag{B.5}$$
$$\frac{\partial \Pi_C}{\partial r}(r,h,\tau,p') = \lim_{\Delta_f,\Delta_e\to 0}\frac{V_C(r_f,h,\tau,p') - V_C(r_e,h,\tau,p')}{r_f - r_e} \tag{B.6}$$

Using the definitions above and taking the ratios of (B.3) and (B.4) yields:

$$-\frac{\frac{\partial V_C}{\partial r}(r',h,\tau,p')}{\frac{\partial \Pi_C}{\partial r}(r',h,\tau,p')} = \frac{\Delta_e(\rho+\eta+\lambda_1+\lambda_2)}{\Delta_f(\rho+\eta+\lambda_0+\lambda_1)} \frac{V_C(r',h,\tau,p') - \frac{w_t+\eta V_E(r,h,\tau,p)+\lambda_1 \tilde{V}_C(\cdot)+\lambda_2 \tilde{V}_E(\cdot)}{\rho+\eta+\lambda_1+\lambda_2}}{\Pi_C(r',h,\tau,p') - \frac{\pi_0+\eta\Pi_0+\lambda_0\tilde{\Pi}_C(\cdot)+\lambda_1\tilde{\Pi}_E(\cdot)}{\rho+\eta+\lambda_0+\lambda_1}} \tag{B.7}$$

Next, define $S(h,\tau,p') = \Pi_C(r',h,\tau,p') + V_C(r',h,\tau,p') - V_E(r,h,\tau,p)$ as the surplus associated with the position. Note that $\Pi_C(0,h,\tau,p') = 0$, which implies that $\Pi_C(r',h,\tau,p') = V_C(0,h,\tau,p') - V_C(r',h,\tau,p')$. Thus, $\frac{\partial \Pi_C}{\partial r}(r',h,\tau,p') = -\frac{\partial V_C}{\partial r}(r',h,\tau,p')$. Applying this to (B.7) and taking the limit as $\eta \to \infty$ yields (after some algebra):

$$V_C(r',h,\tau,p') = \beta_0 V_C(0,h,\tau,p') + (1-\beta_0)V_E(r,h,\tau,p) \tag{B.8}$$

where $\beta_0 = \frac{\Delta_f}{\Delta_f+\Delta_e}$.[1] Note that the sharing rule implies that it is in the executive's interest to accept the promotion to CEO if and only if $V_C(0,h',\tau',p') > V_E(r,h',\tau',p)$. Define $\overline{\theta_0}(r,h,\tau,p)$ as the critical level of match productivity such that:

$$V_C(0,h,\tau,\overline{\theta_0}) = V_E(r,h,\tau,p) \tag{B.9}$$

If $p' > \overline{\theta_0}$, the executive accepts the CEO role under the wage contract defining (B.8). If $p' \leq \overline{\theta_0}$, the executive can never be swayed into accepting the CEO role and instead remains in their current position.

Derivation of sharing rule for horizontal moves (Executive). Consider an executive who is approached by an outside firm to serve in an executive position. Upon the arrival of the offer, the executive along with the competing and incumbent firms initiate a bargaining game with the following structure:

[1] Under this game-theoretic interpretation of the bargaining parameter, the executive's bargaining power increases in the time Δ_f it takes the firm to come up with a counteroffer. This is fairly unimportant and in no way changes the empirical treatment of the parameter β_0. Also, the form of the sharing rules hinges on the assumption that the separation rate η is large relative to the arrival rates of competing offers. This is a technical assumption that for our purposes will be buried in the appendix.

1. Stage 1: Both firms simultaneously offer a piece rate to the executive

2. Stage 2: The executive chooses one of the offers, or rejects and keeps their current position.

3. Stage 3: If the executive accepted an offer in Stage 2, some time elapses. The executive then renegotiates with the firm whose offer was rejected, where the renegotiation protocol mirrors that of the previous section. Unlike the previous section, however, the executive's outside is option is not their current position, but the offer accepted in Stage 2.

The bargaining game is solved via backward induction. Let r_1' and r_1 denote the Stage 1 offers from firms p' and p. Suppose that r_1 was accepted in the second stage, triggering a Stage 3 renegotiation with firm p'. The offer from p' will satisfy:

$$V_E(r, h, 0, p') = \beta_1 V_E(0, h, 0, p') + (1 - \beta_1) V_E(r_1, h, \tau, p) \tag{B.10}$$

Conversely, suppose that r_1' was accepted in Stage 2. In the subsequent renegotiation with firm p, their counteroffer will satisfy:

$$V_E(r, h, \tau, p) = \beta_1 V_E(0, h, \tau, p) + (1 - \beta_1) V_E(r_1', h, 0, p') \tag{B.11}$$

The form of the counteroffers implies that:

- If r_1' was accepted in Stage 2, renegotiate and eventually work with p iff:

$$V_E(0, h, \tau, p) \geq V_E(r_1', h, 0, p') \tag{B.12}$$

- If r_1 was accepted in Stage 2, renegotiate and eventually work with p' iff:

$$V_E(0, h, 0, p') > V_E(r_1, h, \tau, p) \tag{B.13}$$

Thus, the value of accepting r_1 at Stage 2 is:

$$V = \max\{\beta_1 V_E(0, h, 0, p') + (1 - \beta_1)V_E(r_1, h, \tau, p), V_E(r_1, h, \tau, p)\} \tag{B.14}$$

Similarly for r_1':

$$V = \max\{\beta_1 V_E(0, h, \tau, p) + (1 - \beta_1)V_E(r_1', h, 0, p'), V_E(r_1', h, 0, p')\} \tag{B.15}$$

Moving back to Stage 1, both firms make simultaneous offers. For firm p' to eventually win the executive, they must bid r_1' such that $V_E(r_1', h, 0, p') > V_E(0, h, \tau, p)$ so that firm p cannot afford to outbid p'. Acknowledging the transferability of p and k, firm p' eventually wins the worker if and only if $p' > p + k'$. In this case, to avoid wasting time in the renegotiation stage, firm p' immediately offers r_1' such that:

$$V_E(r_1', h, 0, p') = \beta_1 V_E(0, h, 0, p') + (1 - \beta_1)V_E(0, h, \tau, p) \tag{B.16}$$

Conversely, if $p' < p + k'$, firm p will eventually win the executive's services. The fastest way of doing so is to immediately offer r_1 such that:

$$V_E(r_1, h, \tau, p) = \beta_1 V_E(0, h, \tau, p) + (1 - \beta_1)V_E(0, h, 0, p') \tag{B.17}$$

Note additionally that a competing offer does not necessitate an alteration of the current piece rate r. The minimal value of p' such that something happens is defined by:

$$V_E(r, h, \tau, p) = \beta_1 V_E(0, h, \tau, p) + (1 - \beta_1)V_E(0, h, 0, \underline{\theta}_E) \tag{B.18}$$

Derivation of sharing rule for external promotions. Consider an executive who is approached by an outside firm to become CEO. A three-player bargaining game is initiated with the same structure as in the previous case. Note, however, that unlike the previous case, the executive is weighing two separate types of positions: a CEO position and a non-CEO position. Because the two position types are associated with different event spaces describing the possible set of future offers, the executive's value of accepting these positions, for a given state, is not equal in general.

As before, the bargaining game is solved via backward induction. Let $(r_1', 1)$ and $(r_1, 0)$ denote the stage 1 offers from firms p' and p, where the second coordinate indicates if the offer is for a CEO position or not. Suppose the executive accepted $(r_1, 0)$ at Stage 2, then renegotiates with p' in Stage 3. The offer from p' will satisfy:

$$V_C(r, h, 0, p') = \beta_1 V_C(0, h, 0, p') + (1 - \beta_1) V_E(r_1, h, \tau, p) \tag{B.19}$$

Conversely, suppose that $(r_1', 1)$ was accepted at stage 2, and a stage 3 renegotiation was triggered with firm p. Firm p's counteroffer will satisfy:

$$V_E(r, h, \tau, p) = \beta_1 V_E(0, h, \tau, p) + (1 - \beta_1) V_C(r_1', h, 0, p') \tag{B.20}$$

Implications:

- If $(r_1', 1)$ is accepted at stage 2, renegotiate and eventually work with p iff:

$$V_E(0, h, \tau, p) \geq V_C(r_1', h, 0, p') \tag{B.21}$$

- If $(r_1, 0)$ is accepted at stage 2, renegotiate and eventually work with p' iff:

$$V_C(0, h, 0, p') > V_E(r_1, h, \tau, p) \tag{B.22}$$

Thus, the value of accepting $(r_1, 0)$ at stage 2 is:

$$V = \max\{\beta_1 V_C(0, h, 0, p') + (1 - \beta_1) V_E(r_1, h, \tau, p), V_E(r_1, h, \tau, p)\} \tag{B.23}$$

Similarly for $(r_1', 1)$:

$$V = \max\{\beta_1 V_E(0, h, \tau, p) + (1 - \beta_1)V_E(r_1, h, 0, p), V_C(r_1', h, 0, p')\} \tag{B.24}$$

At stage 1, simultaneous offers are made. For firm p' to win the executive, they must bid r_1' such that: $V_C(r_1', h, 0, p') > V_E(0, h, \tau, p) = V_C(0, h, \tau, \overline{\theta_0})$. Again acknowledging the transferability of k and p, the previous inequality is equivalent to $V_C(r_1', h', 0, p') > V_C(0, h', 0, \overline{\theta_0} + k')$. Hence, firm p' eventually wins the worker if and only if $p' > \overline{\theta_0} + k'$. In this case, to avoid wasting time in the renegotiation stage, firm p' immediately offers r_1' such that:

$$V_C(r_1', h, 0, p') = \beta_1 V_C(0, h, 0, p') + (1 - \beta_1)V_E(0, h, \tau, p) \tag{B.25}$$

Conversely, suppose that $p' < \overline{\theta_0} + k'$. Similar to the above case, firm p will retain the worker in the fastest manner possible by immediately offering r_1 such that:

$$V_E(r_1, h, \tau, p) = \beta_1 V_E(0, h, \tau, p) + (1 - \beta_1)V_C(0, h, 0, p') \tag{B.26}$$

As in the case of horizontal moves, an outside offer for a CEO appointment need not trigger a change in the current piece rate r. The minimum value of p' such that something happens is defined by:

$$V_E(r, h, \tau, p) = \beta_1 V_E(0, h, \tau, p) + (1 - \beta_1)V_C(0, h, 0, \underline{\theta}_O) \tag{B.27}$$

Derivation of sharing rule for horizontal moves (CEO). This one is essentially identical to the case for executives, just change the E subscript to C. The implied threshold condition is:

$$V_C(r, h, \tau, p) = \beta_1 V_C(0, h, \tau, p) + (1 - \beta_1)V_C(0, h, 0, \underline{\theta}_C) \tag{B.28}$$

C. Estimation Details