Succession*

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Abstract

How do boards manage CEO succession? We develop a real options model where boards learn about CEO and successor ability while making hiring and firing decisions. Because boards continuously observe internal candidates while external candidates remain uncertain until hired, learning drives the prevalence of internal successions. Counterintuitively, internal successions increase with more efficient labor markets: lower search costs improve succession pipelines more than they ease external hiring. However, boards' incentives to learn about successors decline when CEOs perform well, leaving firms vulnerable to succession crises. Our model suggests that appointment delays and apparent absence of succession planning reflect optimal responses to replacement costs and option value rather than governance failures.

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JEL Classifications: G30, G34, M12.

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I Introduction

Few board decisions matter more than CEO succession. Every year, approximately 12% of large U.S. corporations appoint a new CEO, affecting over $7 trillion in market capitalization. These succession decisions create or destroy 2-3% of firm value—approximately $180 billion annually.[1] Yet three puzzles arise: 80% of successions promote internal candidates despite competitive labor market models suggesting external hires should dominate (Parrino, 1997; Cziraki and Jenter, 2022), many firms lack succession plans despite boards ranking it a top priority (Larcker and Tayan, 2020; Cvijanović et al., 2022), and firms experience lengthy delays in appointing new CEOs even when vacancies are costly (Rivolta, 2018). Given CEOs' lasting impact on firms (Bertrand and Schoar, 2003; Bandiera et al., 2020; Bennedsen et al., 2020; Jenter et al., 2024), understanding how boards manage these succession decisions is essential.

To study how boards manage CEO succession, we develop a dynamic model where boards learn about CEO and successor ability while making hiring and firing decisions. Our central insight is that learning about internal candidates fundamentally changes succession economics. Boards continuously observe internal candidates while external candidates remain uncertain. Therefore, employing a successor creates option value that can dominate the benefits of a broader external search.

This framework generates two counterintuitive predictions. First, more efficient executive labor markets lead to more, not fewer, internal successions. This happens because lower search frictions improve succession pipelines more than they ease external hiring. Second, firms with the highest-ability CEOs are most vulnerable to succession crises: when the incumbent performs well, boards rationally underinvest in evaluating successors, leaving

[1] Jenter and Lewellen (2021) report that the average CEO tenure is 8.2 years, implying an annual turnover rate of approximately $1/8.2 \approx 12\%$, which is broadly consistent with the 11.2% documented by Larcker and Tayan (2022). As of January 2026, with the S&P 500 valued at over $60 trillion, CEO turnover therefore affects roughly $7 trillion of market value each year (60×0.12 trillion). Jenter et al. (2024) further find that cumulative abnormal returns around a sudden CEO death average -1.72%, and -3.38% for younger CEOs.

firms unprepared for unexpected departures. The same option value that drives internal succession also rationalizes delays in CEO appointments and the apparent absence of formal succession plans—boards optimally wait to resolve uncertainty about successors rather than rushing suboptimal appointments.

In our model, the firm employs both a CEO and a designated successor, such as the current COO or president. Over time, the board learns about the abilities of both by closely monitoring their performance (e.g., Cornelli et al., 2013). At any time, the board can replace the CEO—at a cost—by either promoting the successor (internal succession) or searching the labor market for an external candidate (external succession). As the board receives information about the successor's capabilities, positive news increases the likelihood of internal succession while negative news shifts the board towards external succession. Crucially, the board also continuously manages the succession pipeline by replacing underperforming successors with external candidates.

Conventional wisdom suggests that lower labor market frictions should lead to more external succession, as it simply becomes easier to hire from the outside. We show the opposite. Lower executive labor market frictions have two effects: they reduce the cost of external CEO hires, but they also reduce the cost of replacing underperforming successors. In particular, when replacing weak successors is cheap, boards continuously learn about successors and manage their succession pipeline, ensuring a high-quality internal candidate is always available. We show that this succession pipeline channel dominates. Consequently, more efficient labor markets lead to more internal successions. Therefore, our results suggest that a high frequency of internal successions (e.g., Cziraki and Jenter, 2022) may reflect well-functioning executive labor markets and need not signal agency conflicts or market inefficiencies (e.g., Hermalin and Weisbach, 1998; He and Schroth, 2024). These findings remain robust when we extend our framework to include firm-specific human capital, internal labor markets, and a labor market equilibrium.

Our model also explains why boards delay CEO appointments and why formal succession

plans are often absent. Three forces drive this result: replacement costs create incentives to wait, the option value of continued learning favors delay over rushing suboptimal appointments, and hiring a weak CEO today increases the likelihood of costly future replacement. Consequently, what appears to be poor governance may instead reflect optimal board decision-making under uncertainty. In line with this result, Larcker and Tayan (2020) find that nearly half of boards would not be able to name a permanent successor if required.

The learning mechanism raises a natural question: How much should boards invest in evaluating successors? In practice, boards determine the extent to which they monitor and learn about executives (e.g., Adams and Ferreira, 2007). We endogenize the board's investment in learning about successors and characterize the optimal speed of learning. Boards optimally reduce monitoring when the incumbent CEO has high expected ability, since replacement appears unlikely. This rational underinvestment leaves firms vulnerable to succession crises when high-ability CEOs depart unexpectedly, providing a theoretical foundation for documented crises (Charan, 2005; Fernández-Aráoz et al., 2021) and an additional mechanism for the decline in performance-turnover sensitivity with CEO tenure (Dikolli et al., 2014).

Our framework offers a unified explanation for all three empirical puzzles through a single mechanism: board learning about successors. The prevalence of internal succession reflects learning and efficient pipeline management, not necessarily market failure. The lack of succession plans and appointment delays reflect the option value of learning, not governance failures. And succession crises emerge precisely at firms that appeared best managed—those with high-ability CEOs whose boards rationally learn less about successors.

Our model generates novel, empirically testable predictions regarding executive tenure, and to our knowledge, it is the first to explicitly derive predictions for successor tenure. We show that faster learning about potential successors extends CEO tenure by improving CEO quality through better succession pipelines, but shortens successor tenure by accelerating promotion or replacement decisions. Similarly, lower executive search costs reduce both

CEO and successor tenure through more aggressive management of the CEO and succession pipeline, whereas higher-quality external candidates increase both tenures. These predictions offer additional avenues for empirically testing our model.

A Related Literature

Our paper contributes to several strands of the literature. First, we contribute to the dynamic corporate finance literature (see e.g. McDonald and Siegel, 1986; Fischer et al., 1989; Grenadier and Malenko, 2011; Bustamante, 2012; Antill and Grenadier, 2019; Bolton et al., 2019; Gryglewicz and Hartman-Glaser, 2020; Garlappi et al., 2022; Chemla et al., 2025). We show that CEO successions can be better understood through the lens of real options: retaining a successor provides option value. To the best of our knowledge, this perspective is new to the succession literature and offers a useful framework for analyzing succession planning and board decision-making.

Second, our work also adds to the theoretical literature on the market for CEOs (e.g., Murphy and Zábojník, 2004; Tsoulouhas et al., 2007; Gabaix and Landier, 2008; Terviö, 2008; Inderst and Mueller, 2010; Garrett and Pavan, 2012; Cao and Wang, 2013; Eisfeldt and Kuhnen, 2013; Anderson et al., 2018; Chaigneau and Sahuguet, 2018, 2023; Donaldson et al., 2020). Most closely related are Hermalin (2005) and Waldman and Zábojník (2024). Hermalin (2005) focuses on learning about CEO post-promotion, while we focus on learning about successor before being promoted. While learning in Hermalin (2005) makes external successions more beneficial by increasing the option value of dismissal, pre-promotion learning in our setup promotes internal successions due to active succession pipeline management. Unlike Waldman and Zábojník (2024), who study the impact of learning about external candidates and firm-specific human capital on CEO succession, we focus on board dynamic learning about internal successors and succession pipeline management. More broadly, our framework highlights the real option nature of successors and generates several novel predic-

tions: lower search costs counterintuitively increase internal succession by improving pipeline management, the existence of appointment delays, and boards' learning incentives endogenously decline with CEO performance, resulting in succession crises.[2]

The remainder of the paper is structured as follows. Section II presents the baseline model. Section III analyses this baseline model and derives the main results. Section IV endogenizes the speed of learning about the successor. Section V summarizes the model's empirical predictions and Section VI concludes. Appendix A contains additional model analysis. Appendix B contains all proofs. Appendix C describes the numerical algorithm used to solve the model and Appendix D the simulation algorithm.

II Model

In this section, we develop a continuous-time model of CEO succession. The firm is owned by risk-neutral shareholders who discount cash flows at rate $r > 0$, and the board runs the firm to maximize shareholders' equity value. The model has two key features. First, the board simultaneously learns about both the current CEO (through observing firm performance) and the successor (through observing their work). Second, the board can replace the CEO—by either promoting the successor or hiring externally—and can also replace underperforming successors; both actions are costly. Because the board can always replace executives with new candidates, this process repeats itself and thus the board faces a repeated real options problem (e.g., Fischer et al., 1989; Mauer and Ott, 1995; Hugonnier et al., 2015).

[2] Hamilton et al. (2023), Celentano and Mello (2024), and He and Schroth (2024) structurally estimate the cost and benefits of succession planning/hiring insiders versus outsiders. In contrast to this work, we allow the board to select and learn about the successor, thereby microfounding the succession planning process and generating novel testable implications. There also exists a related theoretical literature in labor economics that analyzes external hires versus internal promotions (e.g., Chan, 1996; Chen, 2005; Waldman, 2003; DeVaro and Morita, 2013). Contrary to this literature, we study the dynamics of external hires versus internal promotions and the endogenous speed of learning. Additionally, see Berns and Klarner (2017) for a review of the CEO succession literature in management and Lazear and Oyer (2007), Waldman (2013), or Oyer and Schaefer (2011) for surveys of the personnel economics literature.

A CEO

We first describe how the board learns about the CEO's ability through observing firm performance. At time zero, the firm employs a CEO with ability $\theta^c \in \{L, H\}$, which can be either low $L = 0$ or high $H = 1$.[3] The firm's cash flows dX_t are influenced by the CEO's ability θ^c

$$dX_t = (\mu + \theta^c)\, dt + \frac{1}{\phi^c} d\tilde{B}_t^c,$$

where $\mu \geq 0$ measures the cash flows unrelated to the CEO's ability, $\frac{1}{\phi^c} \geq 0$ is the cash flow volatility, and $\tilde{B}_t^c$ is a standard Brownian motion.[4]

The CEO's ability θ^c is unknown to the board, whose prior about it being high is $c \in [0, 1]$.[5] As a consequence, the board updates its beliefs about the CEO's ability by learning from the cash flows dX_t. Let $C_t = \mathbb{E}_t[\theta^c]$ be the CEO's expected ability given the information acquired by the board up to time t. The CEO's expected ability C_t can also be interpreted as the probability that the CEO's ability is high, as $L = 0$ and $H = 1$. As in Daley et al. (2024), Bayes' rule implies that the dynamics of the CEO's expected ability are

$$dC_t = \phi^c C_t(1 - C_t)\phi^c(dX_t - (\mu + C_t)\, dt) = \phi^c C_t(1 - C_t) dB_t^c, \tag{1}$$

where B_t^c is a standard Brownian motion given the information available to the board. From this equation it becomes clear that a higher speed of learning ϕ^c (less noisy and therefore more informative cash flows) leads to a faster updating of beliefs. Furthermore, when beliefs are close to either zero or one, they move at a slower pace as Bayes' rule implies that more

[3] This ability can also be interpreted as the fit with the firm.

[4] While compensation plays an important role in generating the right incentives for executives (Edmans et al., 2017), we abstract from studying CEO's (or successor's) optimal compensation to keep our model tractable and focus on analyzing the board's optimal succession policy (similar to, e.g., Taylor, 2010; He and Schroth, 2024).

[5] Only the board undertakes actions and therefore it does not matter what the CEO and successor know.

information is required to change beliefs.

Given the board's beliefs, the CEO's expected ability C_t thus directly impacts the firm's performance (Bertrand and Schoar, 2003; Bandiera et al., 2020) as the cash flows are

$$dX_t = (\mu + C_t)\, dt + \frac{1}{\phi^c} dB_t^c.$$

If the firm does not employ a CEO at time zero, then it generates cash flows $\mu dt + \frac{1}{\phi^c} dB_t^c$, which is equivalent to $c = 0$. This situation can also be interpreted as the firm employing an *interim CEO* with low ability at no cost. The firm is run by this interim CEO until the board appoints a new (permanent) CEO.

For parsimony, we assume that the firm's *current* cash flows only depend on the CEO's ability and not on that of the successor, which we discuss in more detail below. In Appendix A.II, we discuss an extension of the model in which the firm's cash flows also depend on the successor's ability and when there is (firm-specific) human capital accumulation.

B Successor

The firm can also employ a successor, who can become the future CEO. The successor could, for example, be the firm's current COO or CFO.[6] The successor's ability is captured by θ^s, which can be either low or high $\theta^s \in \{0, 1\}$ and is unknown to the board, whose prior about it being high is $s \in [0, 1]$.

While the board learns about the CEO through firm performance, it also learns about the successor by observing their work (Harris and Holmstrom, 1982; Cornelli et al., 2013). This idea is supported empirically by Fee and Hadlock (2004), who document that "*firms continually update their assessments of their non-CEO senior executive personnel and regularly remove suboptimal managers*". Formally, the board receives news Y_t about the successor's

[6] Larcker and Tayan (2022) report that new CEOs most commonly held positions as president or division head (33%), COO (27%), or CFO (9%) immediately prior to appointment.

ability, which evolves according to the following dynamics

$$dY_t = \theta^s dt + \frac{1}{\phi^s} d\tilde{B}_t^s,$$

where $\phi^s \geq 0$ is the speed of learning about the successor's ability and $\tilde{B}_t^s$ is a standard Brownian motion, which is independent of $\tilde{B}_t^c$. In Section IV, we endogenize the speed with which the board learns about the successor.

As in the case of the CEO, this setup implies that the dynamics of the successor's expected ability given the board's information up to time t, $S_t = \mathbb{E}_t[\theta^s]$, are

$$dS_t = \phi^s S_t(1 - S_t)\phi^s(dY_t - S_t dt) = \phi^s S_t(1 - S_t) dB_t^s, \tag{2}$$

where B_t^s is a standard Brownian motion, which is independent of B_t^c, given the information available to the board. If the firm does not employ a successor at time zero, then $s = 0$. From now on, all dynamics of the state variables (c, s) and expectations are under the board's beliefs.[7]

C Succession

We now turn to the board's succession decisions: when to replace the CEO, who should replace them, and how to manage the succession pipeline. CEOs depart for both exogenous reasons (e.g., death or health; Nguyen and Nielsen, 2014; Bennedsen et al., 2020) and endogenous reasons (e.g., poor performance; Gao et al., 2017; Jenter and Lewellen, 2021). We model exogenous departures as arriving with intensity $\lambda \geq 0$, independent of the CEO's expected ability c, in line with Huson et al. (2004), who find little correlation between per-

[7] We could allow the dynamics of C_t (Equation 1) and S_t (Equation 2) to be correlated. This would allow us to study how the CEO's and the successor's expected abilities relate. Doing so would not fundamentally alter the underlying economic trade-offs highlighted in the paper. However, solving the full filtering problem in the case when the signals dX_t and dY_t are correlated is outside the scope of this paper.

formance and voluntary turnover. Endogenous departures occur when the board decides to replace the CEO.

Appointing a new CEO incurs a cost $K \geq 0$ (e.g., Taylor, 2010). This cost includes direct expenses such as deferred compensation or golden parachutes, and indirect costs such as stock price pressure or personnel turnover. Taylor (2010) and Nickerson (2013) estimate these costs at 1.33–2.18% of firm assets. The parameter K may also capture costs perceived by the board, such as board capture (e.g., Page, 2018). Let τ_C denote the time at which the board appoints a new CEO. If the board promotes the successor to CEO, cash flows dX_t become dependent on the successor's ability, which is high with probability $S_{\tau_C^-}$.[8]

The board can also search the executive labor market to replace either the CEO or the successor, at a fixed cost $\Phi \geq 0$. This cost captures expenses such as executive search firms (Khurana, 2000) or sign-on bonuses (Xu and Yang, 2016). External candidates have ability $\theta^e \in \{0, 1\}$, unknown to the board, with expected ability $e \in [0, 1]$. For tractability, we assume e is common to all external candidates and known ex ante. In Appendix A.III, we discuss how our results are robust when the expected ability of external candidates is unknown ex ante and when the board learns about the external candidates' ability.

When the board searches the external labor market, at time τ_E, it has two options. First, it can replace the CEO with the external candidate, bearing the replacement cost K and search cost Φ. In this case, firm cash flows become dependent on the external candidate with expected ability e. Second, it can replace the current successor with the external candidate at no additional cost beyond Φ; the news process then reflects the external candidate's ability rather than the former successor's. Since the board knows the external candidate's expected ability before hiring, it never incurs the search cost without making a hire. As the firm can replace both the CEO and successor multiple times, the board's problem corresponds to a repeated real option.

[8] t^- indicates the left limit of t.

Remark (Internal versus External Wedge): The cost of hiring a new external CEO is $K + \Phi$, while the cost of promoting a successor is K. Φ can thus also be interpreted as the wedge in hiring/promotion cost between internal and external CEOs.

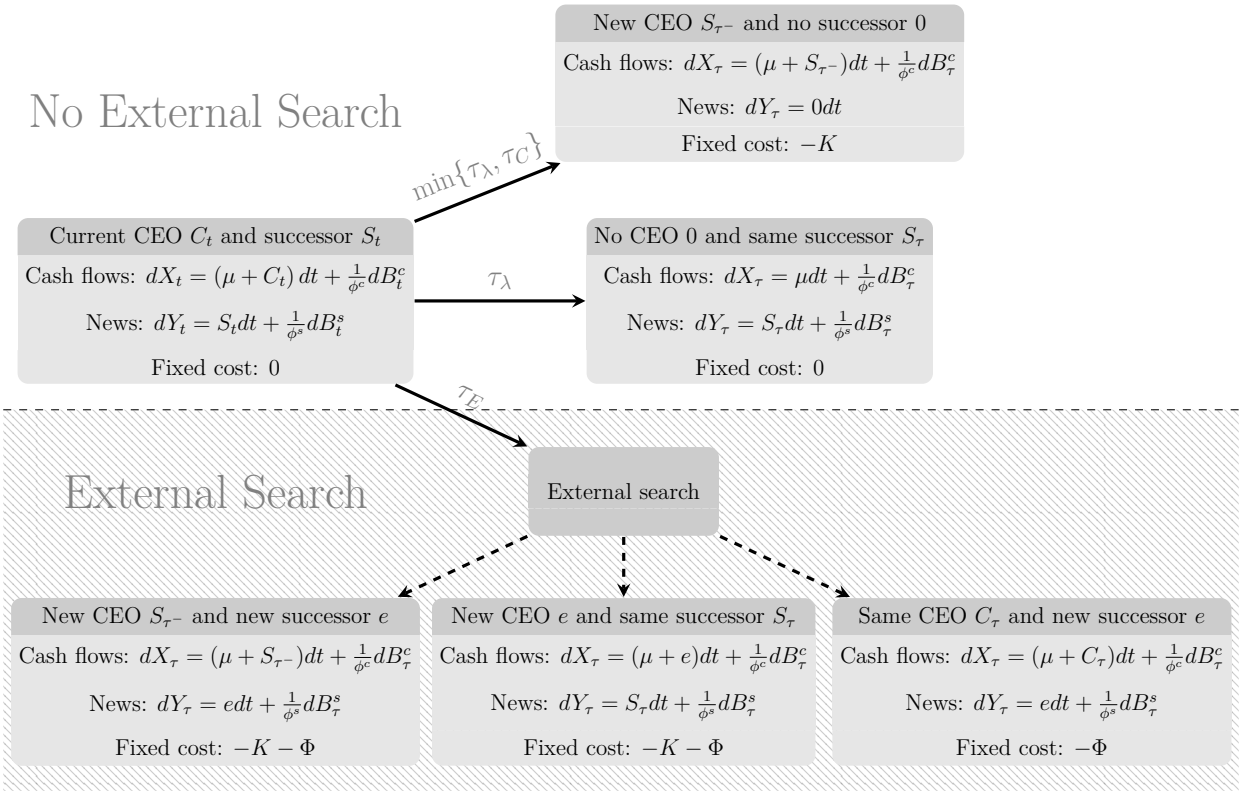


Figure 1: **Management Reshuffles.** The figure describes all possible transition dynamics within the management, including the new cash flows and news that the firm generates given the board's beliefs, and possible fixed costs of hiring and search it incurs. $\tau = \min\{\tau_\lambda, \tau_C, \tau_E\}$.

Figure 1 plots all of the possible management reshuffles in the model. When the firm is run by a CEO with expected ability C_t and a successor with expected ability S_t, the firm generates cash flows $dX_t = (\mu + C_t)\,dt + \frac{1}{\phi^c}dB^c_t$ and news $dY_t = S_t dt + \frac{1}{\phi^s}dB^s_t$. When the CEO departs (either exogenously at τ_λ or endogenously at τ_C) and the board did not conduct an external search ($\min\{\tau_\lambda, \tau_C\} < \tau_E$), then the board has two options:

1. *Promote the successor to become the CEO.* In this case, the firm bears the fixed cost K and the cash flows become $dX_\tau = (\mu + S_{\tau^-})dt + \frac{1}{\phi^c}dB^c_\tau$, where $\tau = \min\{\tau_\lambda, \tau_C, \tau_E\}$ and there is no news $dY_\tau = 0dt$.

2. *Not appoint any CEO.* In this case, the firm generates cash flows $dX_\tau = \mu dt + \frac{1}{\phi^c}dB^c_\tau$ and the news remains $dY_\tau = S_\tau dt + \frac{1}{\phi^s}dB^s_\tau$.

When the board searches for an external candidate (at τ_E), which requires incurring the search cost Φ, the board has three possible options:

1. *Replace the current CEO by the external candidate.* In this case, the cash flows become $dX_\tau = (\mu + e)dt + \frac{1}{\phi^c}dB^c_\tau$, the news remains $dY_\tau = S_\tau dt + \frac{1}{\phi^s}dB^s_\tau$, and the firm incurs the replacement cost K.

2. *Replace the CEO by the successor and appoint the external candidate as the new successor.* Under this scenario, the cash flows become $dX_\tau = (\mu + S_{\tau^-})\,dt + \frac{1}{\phi^c}dB^c_\tau$, the news becomes $dY_\tau = edt + \frac{1}{\phi^s}dB^s_\tau$, and the firm incurs the replacement cost K.

3. *Replace the successor by the external candidate.* If this happens, the cash flows remain at $dX_\tau = (\mu + C_\tau)\,dt + \frac{1}{\phi^c}dB^c_\tau$ but the successor now has expected ability e instead of S_{τ^-} and therefore the news becomes $dY_\tau = edt + \frac{1}{\phi^s}dB^s_\tau$.

The board can also replace both the CEO and successor with external candidates at once. This would be equivalent to performing an external search twice, as in Figure 1, with one search resulting in replacing the CEO and the other search in replacing the successor.

D Equity Value

We now characterize the firm's equity value, which the board maximizes through its succession decisions. Our setup implies that the equity value $V(c, s)$ depends on the expected abilities of both the CEO (c) and the successor (s). If at time zero the firm employs no

CEO, then $c = 0$ and if at time zero the firm employs no successor, then $s = 0$. Let $\tau = \min\{\tau_\lambda, \tau_C, \tau_E\}$ be the time when there is a management reshuffle; then the equity value is

$$
\begin{aligned}
V(c,s) = \sup_{\tau_C,\tau_E} \Bigg\{ & \underbrace{\mathbb{E}_{c,s}\left[\int_0^\tau e^{-rt} dX_t\right]}_{\substack{\textit{Cash flows under} \\ \textit{current CEO}}} \\
& + \underbrace{\mathbb{E}_{c,s}\left[\mathbb{I}_{\{\tau<\tau_E\}} e^{-r\tau} \max\{V(S_{\tau^-},0) - K, V(0,S_\tau)\}\right]}_{\textit{No external search}} \\
& + \underbrace{\mathbb{E}_{c,s}\left[\mathbb{I}_{\{\tau=\tau_E\}} e^{-r\tau} \left(\max\{V(e,S_\tau) - K, V(S_{\tau^-},e) - K, V(C_\tau,e)\} - \Phi\right)\right]}_{\textit{External search}} \Bigg\},
\end{aligned} \tag{3}
$$

where the operator $\mathbb{E}_{c,s}[\cdot]$ denotes an expectation given the board's beliefs conditional on employing a CEO and a successor with initial expected abilities c and s, respectively. The board selects the CEO replacement strategy τ_C and the external search strategy τ_E to maximize the equity value. The first term in Equation (3) corresponds to cash flows generated by the current CEO, dX_t, up until the time when management changes, τ. The second term reflects what happens when the CEO leaves and the firm has no external candidate, $\tau < \tau_E$. In this case, the board either replaces the CEO by the successor $V(S_{\tau^-}, 0) - K$ or appoints no new CEO and keeps on employing the successor $V(0, S_\tau)$. The third term captures the effect of searching for an external candidate $\tau = \tau_E$. In that case, the external candidate can either *i*) replace the CEO $V(e, S_\tau) - K$, *ii*) replace the successor and the successor becomes the CEO $V(S_{\tau^-}, e) - K$, or *iii*) replace the successor $V(C_\tau, e)$. These three different scenarios are also summarized in the external search part of Figure 1. When doing an external search, the firm incurs the search cost Φ. In Appendix A, we study how executives' expected abilities affect the firm's equity value and analyze their departure policies.

From the equity value and the cash flows dX_t it also follows that the firm always generates

cash flows μdt, which is independent of the ability of the CEO.[9] As we show in Corollary 1, since these cash flows are unrelated to the CEO's ability, the board does not take them into account when determining the optimal succession policy.

Corollary 1 (Non-CEO Cash Flows μdt and Optimal Policies)**.** *The firm value* $V(c, s)$ *satisfies*

$$V(c, s) = V(c, s|\mu = 0) + \frac{\mu}{r},$$

and therefore the board's optimal policies do not depend on the cash flows unrelated to the CEO's ability μ*.*

E Succession Policies and Learning Dynamics

To illustrate the model's optimal policies, we characterize how board actions vary across the state space of expected CEO and successor abilities and present sample paths that highlight the dynamics of these policies. Figure 2 depicts all the different actions taken by the board depending on the state variables (c, s). Specifically, there are five different regions of the state space. In the white region, the board does not undertake any action and the current management continues running the firm. The CEO and successor are of sufficient expected ability and thus the board has no incentive to replace either of them. In the blue region, the successor is promoted and a new successor is appointed. The successor is significantly better than the current CEO and therefore the board decides to replace the CEO with the successor and then fill the vacant successor position with an external candidate. In the light red region, a new external CEO is appointed. The outside candidates dominate both the current CEO and the successor. Therefore, the board replaces the CEO with an external candidate. In the dark red region, both the CEO and the successor are replaced by external

[9]This result arises because the shareholders have no incentive to default since $V(c, s|\mu = 0) \geq 0$ and $\mu \geq 0$.

candidates, since the board believes that their expected ability is insufficient. In the gray region, only a new successor gets appointed. The successor is sufficiently worse than the external candidates and therefore is replaced by the board.

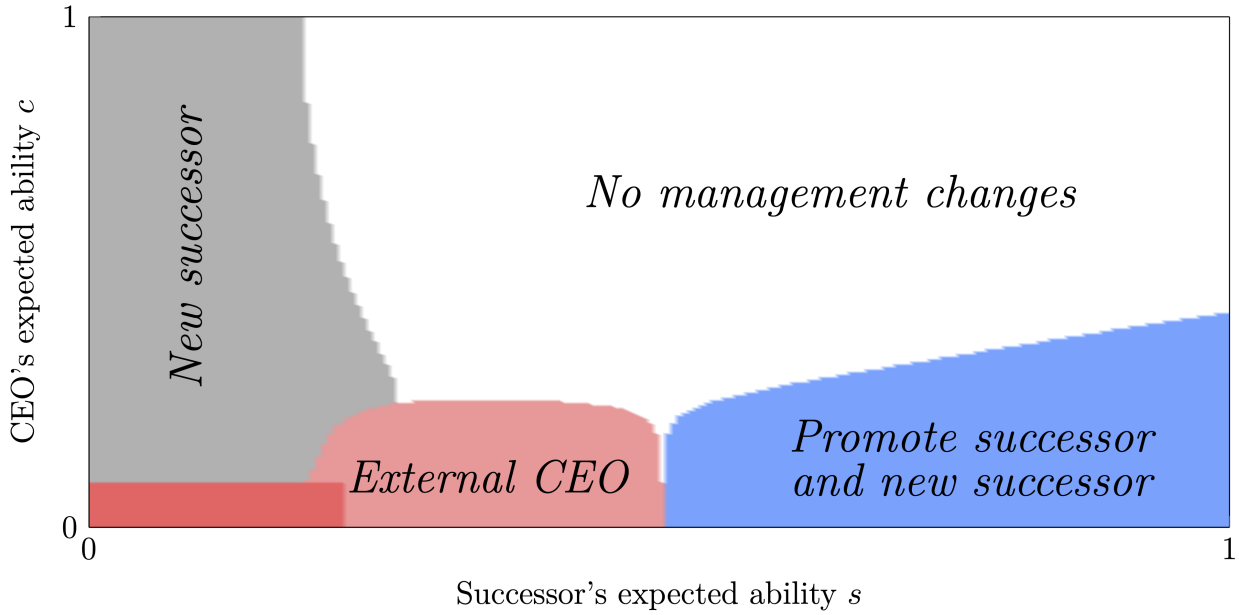


Figure 2: **Optimal Succession Policy**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

We provide further intuition about the optimal policies by illustrating the dynamics of CEO and successor expected abilities in Figure 3, which shows three possible sample paths of the state variables (c, s).

1. (c_1, s_1): The CEO's and successor's expected abilities are (c_1, s_1). The board receives negative news about the successor and positive news about the CEO, which moves the expected abilities to (c_1', s_1'). This makes it optimal for the board to replace the successor since the likelihood of the successor becoming a suitable CEO in the future is too low. As a consequence, (c, s) jumps to (c_1', e).

2. (c_2, s_2): The CEO's and successor's expected abilities are (c_2, s_2). The CEO is of high

expected ability, and so is the successor, but then the CEO leaves for exogenous reasons at τ_λ and the expected abilities move to $(0, s_2)$. The board decides to act by promoting the successor and hiring a new successor, and the expected abilities end up at (s_2, e).

3. (c_3, s_3): The CEO's and successor's expected abilities are (c_3, s_3). The board receives negative news about the successor and CEO, which drives down the expected abilities to (c_3', s_3'). At this point, the CEO is no longer sufficiently able and the board replaces the CEO with an external candidate, which moves the expected abilities to (e, s_3').

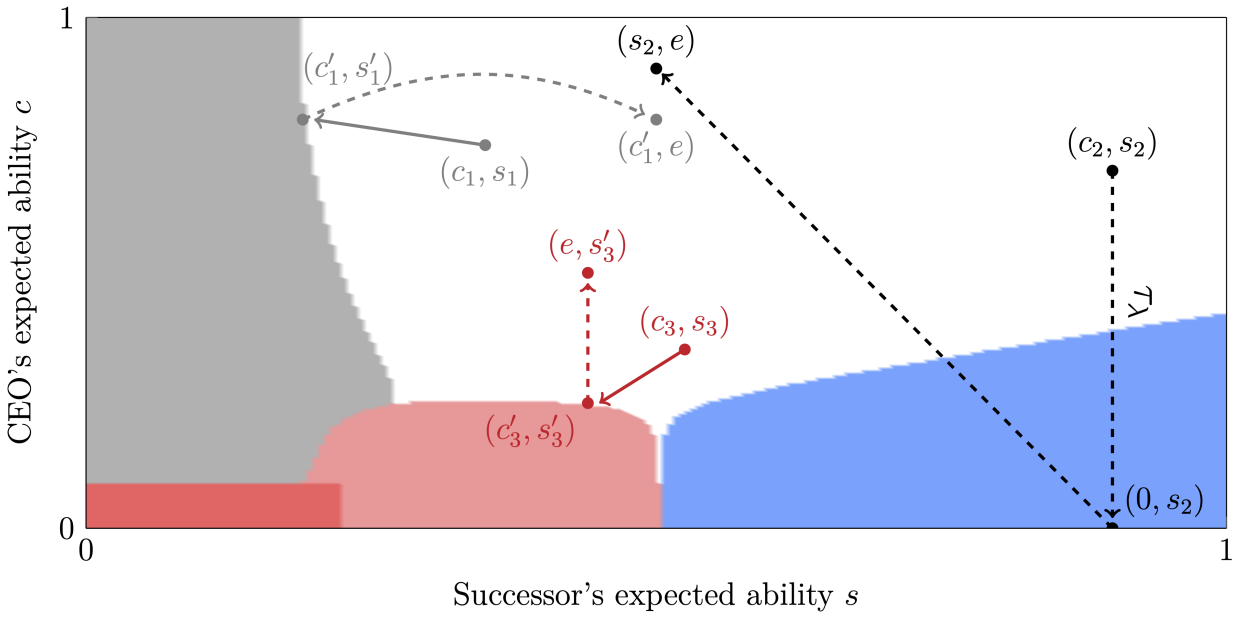


Figure 3: **Different Sample Paths**. The figure shows the solution of the model and state variables (c, s) dynamics given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

III Model Analysis

In this section, we analyze the model's predictions about the firm's succession planning, who becomes the new CEO, as well as CEO and successor expected tenure.

A Succession Planning

We first analyze the issue related to the *lack* of succession planning. In our model, firms can be optimally run without a CEO, $V(0, S_\tau)$, or without a successor, $V(S_\tau, 0)$, as shown by Figure 1 and Equation (3). As we discussed before, having no CEO can also be interpreted as the firm employing an interim CEO. Importantly, both succession strategies are optimal since they result from the board's maximizing the equity value. Therefore, having no successor in place and the apparent absence of succession planning—no direct replacement of a departing CEO—may not indicate that the firm is poorly run, as suggested by prior work (Charan, 2005; Fernández-Aráoz et al., 2021).

Our model suggests that there are three reasons why the board might not appoint a new CEO. First, appointing a new CEO is costly to the firm, as the fixed replacement cost is K. Second, the option value of delaying management reshuffle due to learning about the successor's ability plays an important role as well. Third, the board might be reluctant to act as hiring a subpar CEO today makes it highly likely that it will be necessary to replace this CEO in the near future, which decreases the benefits of hiring such a CEO today. This effect arises due to the fact that the real option embedded in the CEO hiring decision repeats over time.[10]

In Proposition 1, we show that the cost K of appointing a new CEO plays an important role in delaying management reshuffles. When this cost is too high, the board strategically delays appointing a new CEO. Furthermore, the more able the successor, the higher the cost

[10]It is possible that hiring a subpar CEO in a static model would be positive NPV, but the firm would still abstain from hiring a new CEO due to the second and third effect.

needs to be to induce the board to forgo appointing a new CEO.

Proposition 1 (Delayed Succession)**.** *For any successor of expected ability s, there exists a replacement cost $\bar{K}(s) \leq \frac{\max\{s,e\}}{r+\lambda}$ with $\bar{K}'(s) \geq 0$ such that for $K > \bar{K}(s)$ the board prefers not to directly appoint a new CEO*

$$\max\{V(s,0) - K, V(e,s) - K - \Phi\} < V(0,s).$$

We further illustrate the mechanism in Figure 4, which shows the board's optimal actions when the replacement cost K is high. If the CEO leaves for an exogenous reason and the successor is currently of low expected ability, then the board will not appoint a new CEO until it is sure that the successor's expected ability is high enough, which happens when it reaches the blue region. The board thus optimally delays succession.

These results justify the existence of the empirically documented lack of succession planning in many corporations and long delays in appointing new CEOs. Larcker and Tayan (2020) report that 49% of boards would not be able to name a permanent successor if required, while Cvijanović et al. (2022) documents that only 16.4% of firms have ever disclosed succession plans. Rivolta (2018) and Gabarro et al. (2022) document lengthy appointment delays.[11] Moreover, if smaller firms bear relatively larger CEO replacement costs, then Proposition 1 implies that succession planning—a direct replacement of a departing CEO—is value destroying for *smaller* firms while it is value-enhancing for *larger* firms. These results are consistent with the evidence of McConnell and Qi (2022) who show that succession planning disclosure destroys value for smaller firms and increases the value of larger firms, Cvijanović et al. (2022) who find that larger firms are more likely to have succession plans, and Gabarro et al. (2022) who document that smaller firms are more likely to have protracted successions.

[11] Rivolta (2018) finds that when there is a delay in CEO appointment following an unplanned CEO departure then this delay is, on average, 112 days.

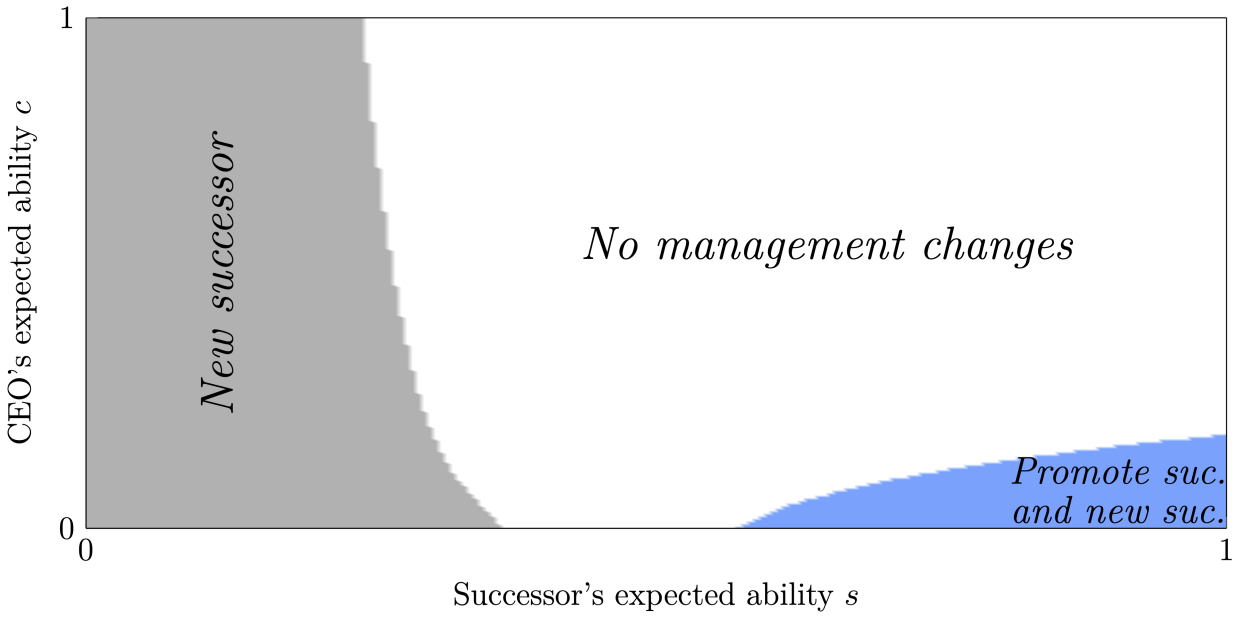


Figure 4: **Delayed Succession**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 2.5, 0.5, 0.35)$. Appendix C describes the numerical algorithm used to solve the model.

B Who Becomes the New CEO?

We next focus on who becomes the new CEO following a management reshuffle. In particular, we want to understand when an external candidate is more likely to replace the CEO than an internal one. We define an *external succession* as the scenario in which the board appoints an external candidate to directly replace the firm's CEO, $c = e$.[12] If the board promotes an internal successor, then we call this an *internal succession*, $c = s$. We show that the incidence of internal and external successions crucially depends on *learning about the successor's ability* by the board. As we demonstrate in Proposition 2, without this channel ($\phi^s = 0$), and when no current successor is in place ($s = 0$), there is no difference between hiring a new CEO internally or externally in terms of the expected cash flows they would generate as CEO. In this case, to delay incurring the search cost, the board optimally hires external candidates

[12]By this we mean that the external candidate is hired at time t and becomes the CEO at time t.

to directly become the CEO instead of hiring an internal successor early on.

Proposition 2 (No Learning)**.** *Assume that the board does not learn about the successor ($\phi^s = 0$), there are costs of searching for an external candidate ($\Phi > 0$), and there is no current successor ($s = 0$). Then in the future there are only external successions.*

In Figure 5, we illustrate the succession dynamics in this case. Because there is no successor at the firm, the firm remains at $s = 0$. The CEO leaves for exogenous reasons at τ_λ or is fired when the CEO's expected ability drops sufficiently, that is to $\underline{c}(0)$. In either case, the board hires an external candidate to become the new CEO. The figure also indicates that the board never hires a successor and provides an example of the succession dynamics in the model. The firm starts at $(e, 0)$, receives positive news about the CEO and moves to $(c', 0)$, after which the CEO leaves for exogenous reasons and gets replaced, so that the firm ends up again at $(e, 0)$. In this case, there are only external successions.

In line with the results in Proposition 2, Figure 7 shows that the likelihood of external successions increases while that of internal successions decreases as the speed of learning about the successor declines. These results highlight that learning about the successor gives the board an incentive to promote internal candidates.

Standard labor market models (e.g., Mortensen and Pissarides, 1994) predict that lower search costs Φ should lead to more external successions, as reduced frictions facilitate hiring from the outside. We show the opposite. Lower search costs have two effects. First, hiring new external CEOs becomes cheaper. Second, hiring new successors is less expensive, leading to more aggressive succession pipeline management. The first effect leads to more external successions, while the second one results in more internal successions. We formally show that the second effect dominates in the limiting case with no search costs, $\Phi = 0$.

Proposition 3 (No Search Cost)**.** *Assume that there are no costs of searching for an external candidate ($\Phi = 0$), the CEO contributes more to the equity value than the successor ($c_1 \geq$*

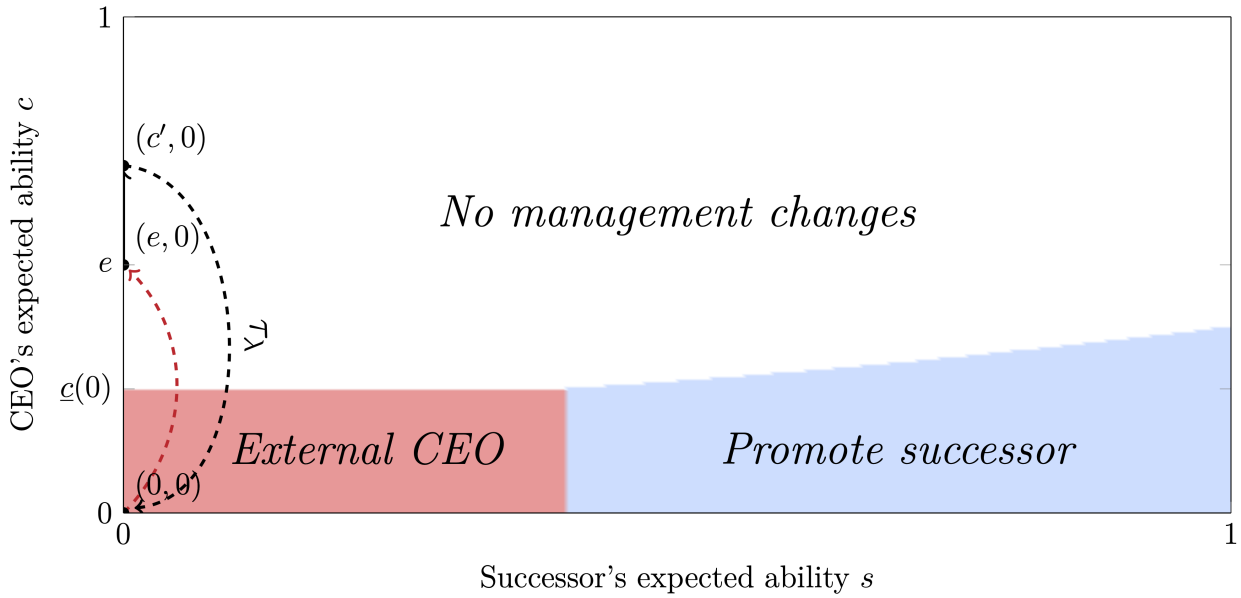


Figure 5: **No Learning Leads to External Successions**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

$c_2 \Rightarrow V(c_1, c_2) \geq V(c_2, c_1)$*), and the firm employs a successor of ability* $s \geq e$*. Then in the future there will only be internal successions.*[13]

Notably, this result still holds when there is no cost of appointing a new CEO, $K = 0$. Figure 8 in the next subsection shows that the succession pipeline channel dominates more generally, leading to higher internal succession rates as search costs decline.

In Figure 6, we illustrate the succession dynamics in this case. The gray area acts as a reflective boundary due to the fact that the board replaces a successor as soon as the successor's expected ability is lower than that of an external candidate. Therefore, the board only replaces the CEO if the successor's expected ability ends up in the blue region,

[13]We assume that if the board is indifferent between appointing the successor or an external candidate to CEO then it appoints the successor, and if the board is indifferent between hiring a new successor or not, then it hires a new successor. Furthermore, we assume that the timing of information arrival and actions at time t is as follows: *i*) τ_λ arrives or not, *ii*) the board decides who to appoint as CEO, *iii*) news about the CEO and the successor arrives, and *iv*) the board decides who becomes the successor.

in which case the successor is promoted to CEO and a new successor is hired. Consequently, in this case there are only internal successions.

We made additional assumptions on the timing of events and preferences when indifferent to obtain the results in Proposition 3, see footnote 13.[14] In almost all the CEO successions, the results do not depend on them. To further highlight the robustness of our results, Figure 8 shows that internal successions become more likely relative to external successions as the search cost declines in line with the underlying mechanism and result of Proposition 3.

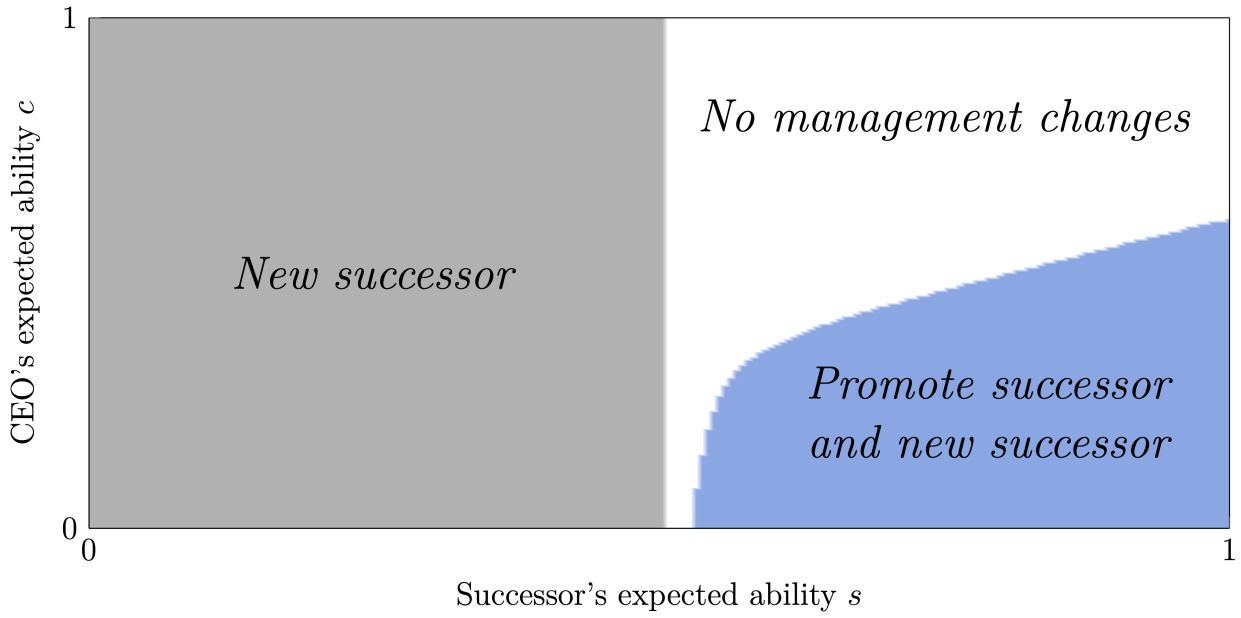


Figure 6: **No Search Cost Leads to Internal Successions**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0)$. Appendix C describes the numerical algorithm used to solve the model.

[14]These assumptions are necessary to handle situations when the board is indifferent and corner cases when $S_t = e$, which has probability zero for any $t > 0$ when $\phi^s > 0$. The first corner case is $S_t = e$ and the CEO leaves for exogenous reasons τ_λ. In this case, the firm can be indifferent between appointing an internal or external CEO and we need to break the tie and assume the board prefers internal over external succession when indifferent. The second case is related to the timing of events when $S_t = e$ as otherwise it can happen that the firm receives negative information about the successor and after that needs to make a replacement decision. We assume that within each dt the board makes CEO replacement decisions before news about the CEO and successor's ability has arrived.

Propositions 2 and 3 together provide some of the key insights of our analysis. First, we theoretically justify why firms appear to prefer hiring internal successors, as documented by Parrino (1997), Huson et al. (2004) or Cziraki and Jenter (2022). In particular, we argue that internal successions are driven by the board learning about the successor, because employing the successor is akin to having a real option. Second, Propositions 2 and 3 demonstrate that firms allow for more internal successions when they have to incur lower search costs ($\Phi \downarrow$) or when they learn faster about the successor ($\phi^s \uparrow$).

Additionally, our results imply that higher levels of internal successions do not necessarily mean that the market for CEOs is inefficient. Proposition 3 shows that the large extent of internal successions observed empirically is also consistent with a more efficient labor market instead of other explanations such as agency conflicts or behavioral biases (e.g., Hermalin and Weisbach, 1998; He and Schroth, 2024).

In Appendix A.III, we show that the results and underlying economic mechanisms of Propositions 2 and 3 extend naturally to a labor market equilibrium, to a setting with candidates of unknown expected ability, and to settings where the board learns about these candidates. We also discuss why the mechanism underlying Proposition 3 continue to hold when the successor influences the firm's cash flows or when firm-specific human capital accumulates, while Proposition 2 remains valid as long as these effects are moderate.

C Succession and Tenure

We next study how different firm characteristics impact succession policy and CEO and successor tenure. Specifically, we examine: CEO endogenous departures (board-initiated firings per year), successor departures (promotions or firings per year), external/internal succession rates (new CEO hires from outside/inside per year), and average CEO and successor tenure.[15] In Appendix D, we describe the simulation algorithm used to calculate these mo-

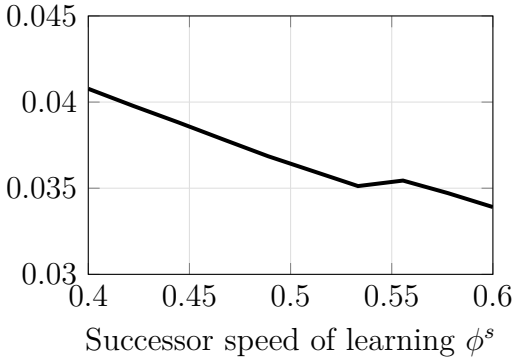
[15]We treat interim CEOs and successors as full-blown CEOs and successors. In the baseline calibration, this assumption does not matter as the firm is never without a CEO or successor.

ments. To the best of our knowledge, our paper is the first to yield empirical predictions about successor tenure.

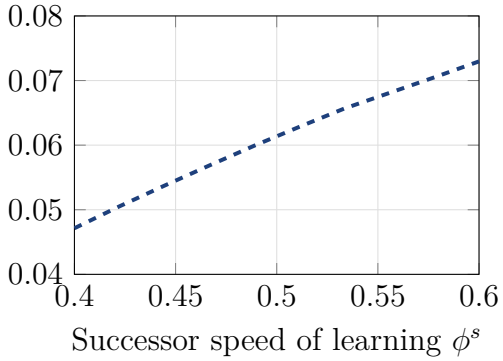
Figure 7 highlights the importance of learning about the successor's ability for CEO succession. With a higher speed of learning ϕ^s about the successor, the firm is more likely to employ a high-ability successor and therefore more likely to have an internal succession (Figure 7(c) and 7(d)). This result is consistent with Proposition 2 that learning about the successor is the crucial driver of internal succession in our model. This faster learning also leads to higher turnover for the successor, who either gets promoted or is let go (Figure 7(b)) and therefore has a shorter tenure as successor (Figure 7(f)). Faster learning about the successor boosts the ability of the new CEO and leads to lower CEO turnover (Figure 7(a)) and longer CEO tenure (Figure 7(e)). This prediction relies on the fact that our model is dynamic, as in a static model, information about the successor (for low enough priors) boosts the chances of the CEO getting replaced and therefore decreases CEO tenure. Our model thus predicts that CEO tenure is positively affected by the speed of learning about the successor, while successor tenure is negatively affected.

Figure 8 illustrates the impact of labor market search cost Φ on equilibrium outcomes. Proposition 3 shows that without any search costs Φ, there are only internal successions, and in line with that result, Figure 8 shows that internal successions become more likely as search costs go down. The reason is that with lower search costs, it becomes cheaper to replace the successor and CEO, which increases their turnover and shortens their tenure (Figure 8(a), 8(b), 8(e), and 8(f)). Our model thus predicts that successor tenure is lower with lower search costs. This more aggressive pipeline management means that the firm employs successors of higher expected ability, which increases the fraction of internal successions relative to total successions as search costs go down (Figure 8(c) and 8(d)).

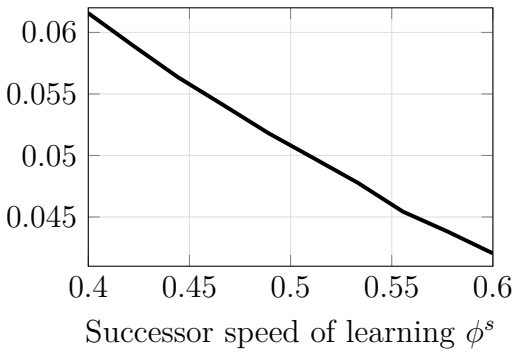
Figure 9 shows the effect of higher-ability external candidates e. Being able to hire better external candidates increases the ability of the CEO and therefore CEO tenure (Figure 9(a) and 9(e)). These better outside candidates also reduce the need for learning about the



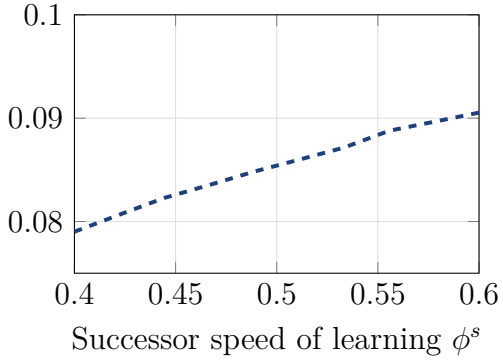
(a) CEO departure rate



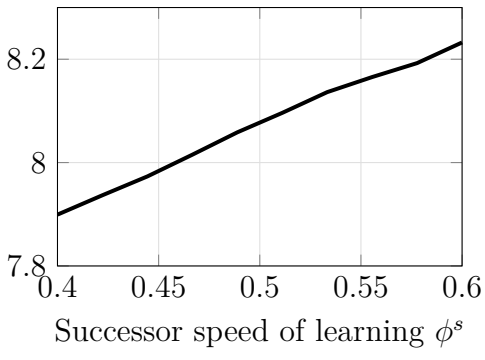
(b) Successor departure rate



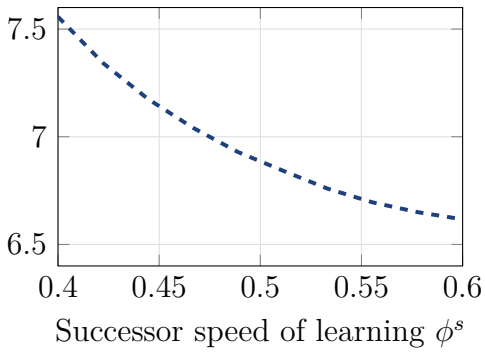
(c) External succession rate



(d) Internal succession rate

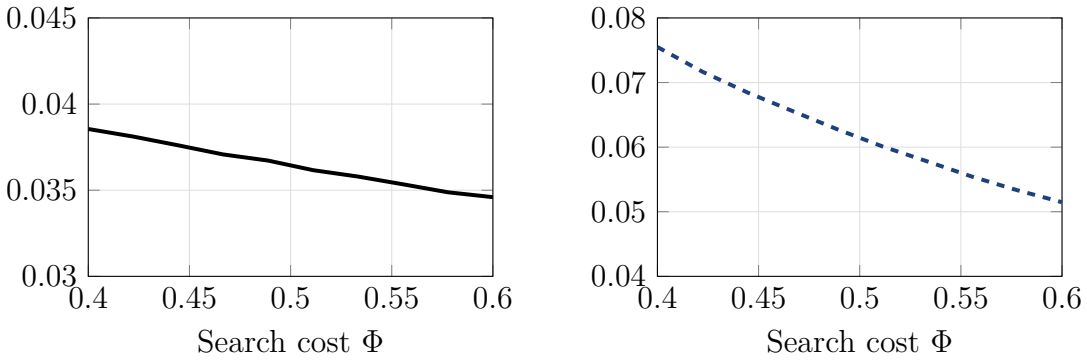


(e) CEO tenure



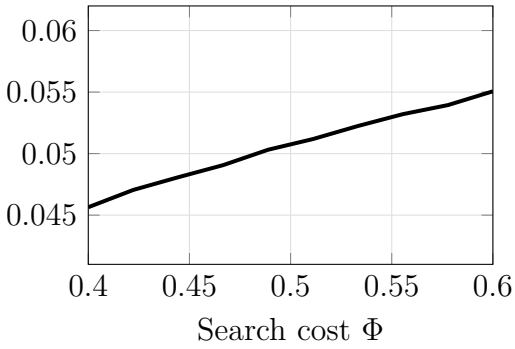
(f) Successor tenure

Figure 7: **Effect of Successor Speed of Learning ϕ^s.** This figure shows the effect of successor speed of learning ϕ^s on CEO and successor departure rates, external and internal succession rates, as well as CEO and successor tenure. The baseline parameter values are $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$.

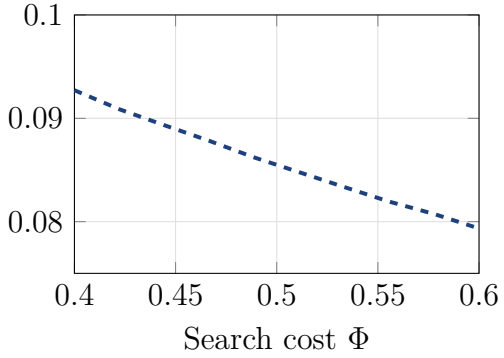


(a) CEO departure rate

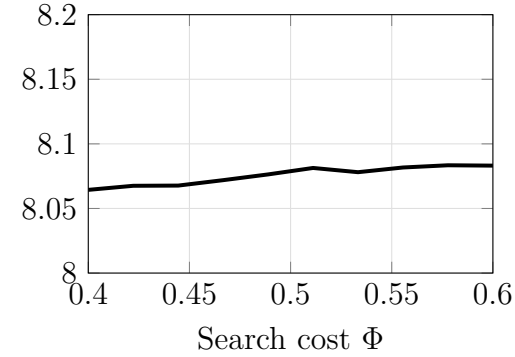
(b) Successor departure rate



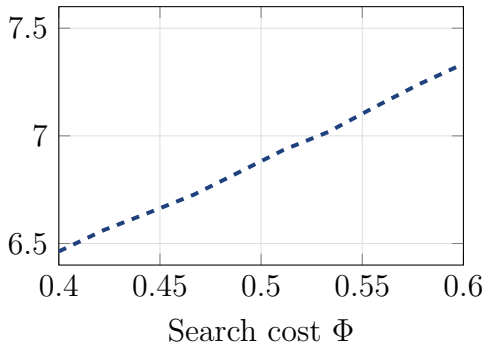
(c) External succession rate



(d) Internal succession rate

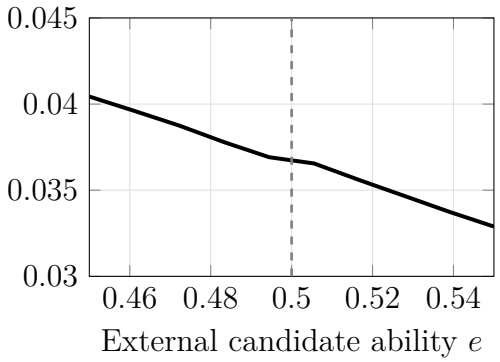


(e) CEO tenure

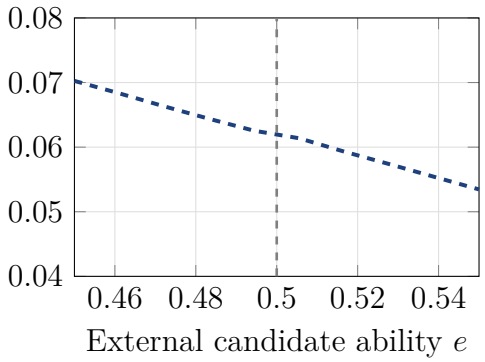


(f) Successor tenure

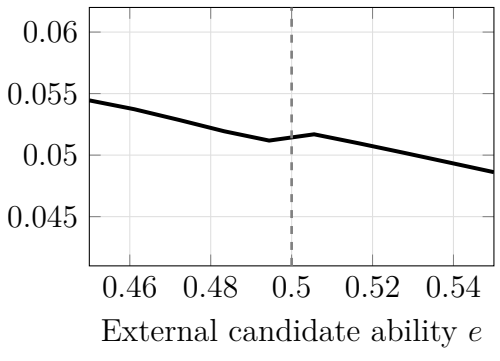
Figure 8: **Effect of Search Cost Φ.** This figure shows the effect of the cost of searching for new executives Φ on CEO and successor departure rates, external and internal succession rates, as well as CEO and successor tenure. The baseline parameter values are $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$.



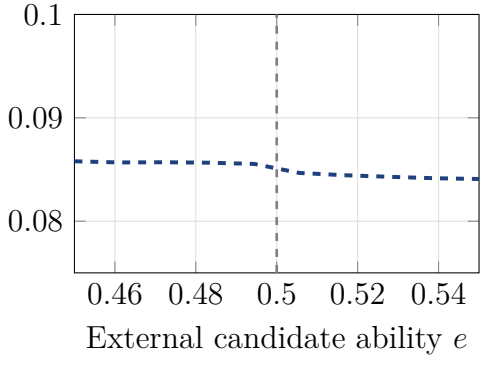
(a) Endogenous CEO departure rate



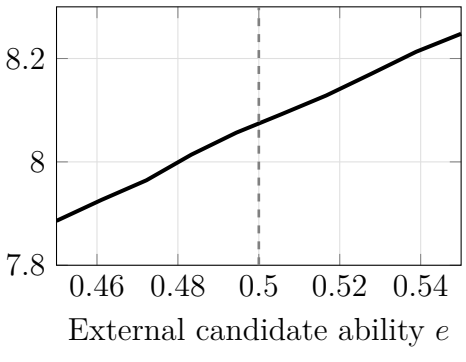
(b) Successor departure rate



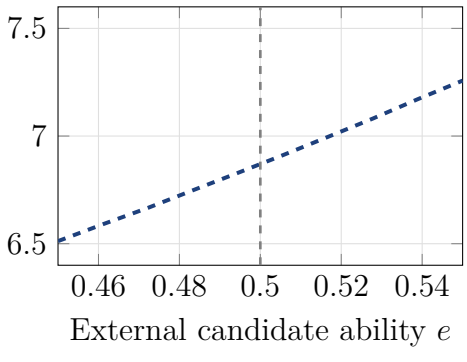
(c) External succession rate



(d) Internal succession rate



(e) CEO tenure



(f) Successor tenure

Figure 9: **Effect of External Candidates Ability e.** This figure shows the effect of the external candidates ability e on CEO and successor departure rates, external and internal succession rates, as well as CEO and successor tenure. The baseline parameter values are $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$.

successor and as a result reduce hiring, which reduces departure rates and lengthens their tenure (Figure 9(b) and 9(f)). The model thus predicts that CEO and successor tenure are positively related to the ability of the candidates that the firm hires.

Appendix A.IV shows additional comparative statics results with respect to the speed of learning about the CEO ϕ^c (Figure A.3), the CEO replacement cost K (Figure A.4), and the exogenous departure rate of CEOs λ (Figure A.2).

IV Endogenous Successor Learning

We have assumed so far that the speed with which the board learns about the successor ϕ^s is exogenous. We now endogenize this choice and study the board's learning incentives.[16] A key finding emerges: boards rationally underinvest in learning about successors when high-ability CEOs are in place, leaving firms vulnerable to succession crises following unexpected departures.

At each time t, the board picks a speed of learning $\phi_t^s \geq 0$ to acquire information about the successor through monitoring and evaluation (Cornelli et al., 2013). This learning comes at a flow cost $L(\phi_t^s)^4 dt$ with a cost of learning parameter $L > 0$.[17] When picking its optimal speed of learning ϕ_t^{s*}, the board trades off the benefits of learning against the cost. From the Hamilton-Jacobi-Bellman (HJB) equation (Equation (A.2) in Appendix B), it follows that for each (c, s) the board picks the speed of learning to maximize benefits minus costs

$$\max_{\phi^s \geq 0} \left\{ \frac{1}{2} (\phi^s)^2 s^2 (1-s)^2 \frac{\partial^2 V(c,s)}{\partial s^2} - L(\phi^s)^4 \right\}.$$

[16] A similar analysis could be done for the CEO. We assume that the CEO's type is revealed through the cash flows the firm generates dX_t and the speed of learning there is determined by the cash flow volatility $\frac{1}{\phi^c}$, which is outside the board's control. Therefore, we focus our analysis in this section on learning about the successor.

[17] Similar results as in Proposition 4 could be obtained for a learning cost function $c(\phi^2)$ where $c', c'' > 0$ and $c'(\infty) = \infty$.

The first term is the effect on the equity value of learning about the successor's expected ability while the second term is the cost of learning.

The benefit of learning has two components. First, learning affects beliefs most when successor ability is most uncertain. From Bayes' rule, the posterior variance $s(1-s)$ is maximized at $s = 0.5$ and decreases as beliefs approach certainty, $s \to \{0, 1\}$. Second, belief changes matter more when they have larger valuation effects. The convexity of equity value, $\frac{\partial^2 V(c,s)}{\partial s^2}$, captures this effect.[18] Solving this optimization problem yields a closed-form characterization of the optimal learning intensity $\phi^{s*}(c, s)$.

Proposition 4 (Optimal Speed of Learning)**.** *The optimal speed of learning about the successor* $\phi^{s*}(c, s)$ *is*

$$\phi^{s*}(c,s) = \frac{1}{2\sqrt{L}} s(1-s) \sqrt{\frac{\partial^2 V(c,s)}{\partial s^2}} \mathbb{I}_{\left\{\frac{\partial^2 V(c,s)}{\partial s^2} > 0\right\}},$$

which is decreasing in the cost of learning L*, increasing in the uncertainty about the successor's ability* $s(1-s)$*, and increasing in the impact of learning about the successor on equity value* $\frac{\partial^2 V(c,s)}{\partial s^2}$*.*

The formula reveals that boards invest most heavily in learning when successor quality is highly uncertain, when information would substantially affect firm value, and when learning costs are low.

Figures 10 and 11 illustrate the optimal learning policy across different states of CEO and successor expected ability. As shown in Proposition 4, learning intensity is highest when successor ability is most uncertain, $s(1-s)$, and when the marginal value of information, $\frac{\partial^2 V(c,s)}{\partial s^2}$, is highest. This occurs when successor expected ability is around $s \approx 0.5$ and when CEO expected ability is low and replacement is likely imminent.

[18] A second-order Taylor expansion around mean beliefs shows that the value of information is approximately $\frac{1}{2} \frac{\partial^2 V(c,s)}{\partial s^2} \text{Var}(\tilde{s})$.

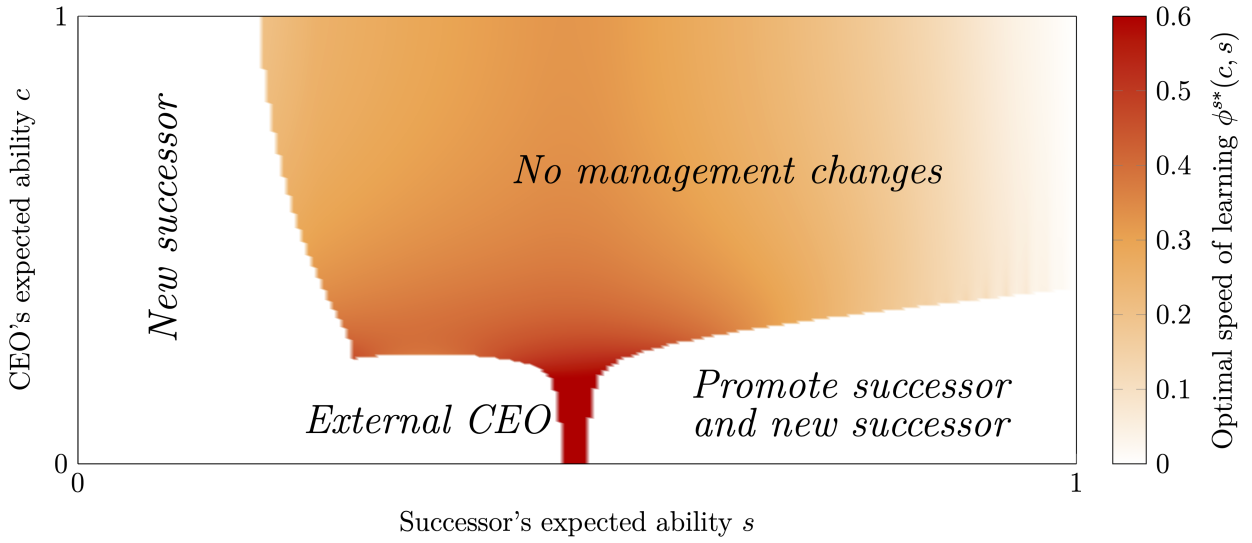


Figure 10: **Optimal Speed of Learning**. The figure shows the optimal speed of learning $\phi^{s*}(c,s)$ given the parameters $(r,\lambda,\phi^c,L,K,e,\Phi) = (4\%,10\%,0.5,1,0.4,0.5,0.5)$. Appendix C describes the numerical algorithm used to solve the model.

Figure 11 reveals an asymmetry in optimal learning policy: boards invest less in evaluating successors precisely when current CEOs have high expected ability. When the incumbent performs well, the probability of needing a replacement declines, making the equity value function less convex in successor quality. Consequently, the marginal value of learning falls, and boards rationally reduce their investment in succession planning.

This endogenous underinvestment mechanism has important implications for both corporate governance and CEO turnover dynamics. First, it provides an additional channel for the documented decline in performance-turnover sensitivity with CEO tenure (Dikolli et al., 2014). Beyond information resolution about CEO ability, boards also optimally reduce monitoring of successors when incumbents have longer tenure and higher expected ability, further dampening performance-turnover sensitivity by making replacement more uncertain and costly.

Second, this creates vulnerability to succession crises. Firms with high-ability CEOs face acute risk: when these CEOs depart unexpectedly—due to health issues, external opportu-

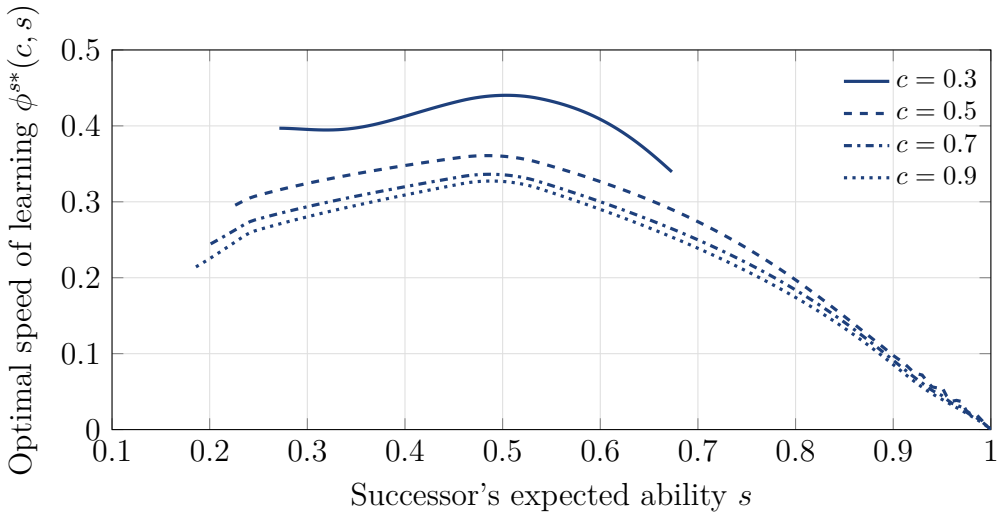


Figure 11: **Optimal Speed of Learning for Fixed CEO Ability.** This figure shows how the optimal speed of learning $\phi^s(c,s)$ varies with successor ability s for different values of CEO expected ability c given the parameters $(r, \lambda, \phi^c, L, K, e, \Phi) = (4\%, 10\%, 0.5, 1, 0.4, 0.5, 0.5)$. Regions where a management change happens are not displayed. Appendix C describes the numerical algorithm used to solve the model.

nities, or sudden performance decline—the firm lacks sufficient information about internal candidates precisely when needed most. Our framework thus provides a theoretical foundation for why succession crises occur even at well-managed firms (Charan, 2005; Fernández-Aráoz et al., 2021), and predicts these crises should be most severe following departures of long-tenured, high-ability CEOs.

V Empirical Implications

Our model generates several testable predictions about CEO succession dynamics. We organize these implications around the model's key frictions and mechanisms.

Successor Learning: Our framework predicts that *internal succession rates should increase with greater learning about the successor*. The reason is that the firm is more likely to employ a high-ability successor, which increases the likelihood of internal succession.

The model also predicts that *CEO tenure should increase with learning speed about successors*. Faster learning yields higher-quality successors, which translates into higher-quality CEOs post-succession, reducing future replacement likelihood. This is a dynamic effect—in a static model, more information about successors would shorten CEO tenure by facilitating replacement. Conversely, *successor tenure should decrease with learning speed* because information resolves faster, leading to quicker promotion (if good) or replacement (if bad), creating more active pipeline management.

Another prediction is that *succession crises should be more likely following the departure of high-ability, long-tenured CEOs*. When incumbent CEOs perform well, boards rationally underinvest in learning about successors, leaving firms vulnerable to unexpected departures. This mechanism helps explain why many firms face succession crises despite claiming succession planning as a top priority (Cvijanović et al., 2022; Larcker et al., 2022). The model predicts that these succession crises should be more severe when the departing CEO has a higher expected ability.

This same underinvestment mechanism also causes *performance-turnover sensitivity to decline with CEO tenure* beyond the direct effect of information resolution about CEO ability. Boards reduce monitoring of successors when CEOs have longer tenure and higher ability, making replacement more uncertain and costly. Dikolli et al. (2014) find evidence for declining performance-turnover sensitivity with tenure; empirical tests could distinguish whether this decline is stronger when boards have less information about potential successors (e.g., firms with less structured development programs or lower internal promotion rates).

Labor Market Efficiency: The model implies that *internal succession rates should increase with lower executive labor market frictions* because of more aggressive succession pipeline management. Firms in industries or time periods with lower executive search costs should exhibit higher rates of internal promotion.

Our framework predicts that both *CEO and successor tenure should decrease with lower*

search costs. Lower frictions enable boards to replace underperforming executives more readily, consistent with Fee and Hadlock (2004)'s evidence that firms continually update assessments of non-CEO executives. This increased turnover is the mechanism behind higher internal successions—the firm more aggressively manages its succession pipeline. Cross-industry variation in executive search costs could help test these predictions, particularly comparing sectors with differing degrees of talent mobility.

Succession Planning and CEO Replacement Costs:

Firms with higher CEO replacement costs (proxied by firm size, regulatory environment, or industry-specific factors) *should exhibit longer delays in CEO appointments and less frequent CEO turnover.* This prediction is consistent with Gabarro et al. (2022)'s finding that smaller firms, which likely face higher replacement costs, experience more protracted successions. More broadly, our model predicts that *firms with higher replacement costs are less likely to have formal succession plans in place.* Consistent with this prediction, Larcker and Tayan (2020) find that nearly half of boards cannot name a permanent successor if required. Our framework shows this can reflect optimal board decision-making when replacement costs are high relative to the option value of learning. Taylor (2010) and Nickerson (2013) estimate replacement costs at 1.33-2.18% of firm assets, suggesting substantial cross-sectional variation that could be exploited empirically.

VI Conclusion

We develop a dynamic model of CEO succession in which boards learn about both CEO and successor ability while making hiring and firing decisions. This framework reveals that employing a successor creates option value through continuous learning and that succession pipeline management is crucial for firms.

Our framework offers a unified explanation for several empirical puzzles through a single

mechanism: board learning about successors. The prevalence of internal succession reflects learning and efficient pipeline management, not necessarily market failure. Counterintuitively, internal successions increase with more efficient labor markets: lower search costs improve succession pipelines more than they ease external hiring. The lack of succession plans and appointment delays reflect the option value of learning, not governance failures. And succession crises emerge precisely at firms that appeared best managed—those with high-ability CEOs whose boards rationally learn less about successors. We also obtain novel testable implications for CEO and successor tenure. Overall, our results show that the real option nature of successors helps us better understand successions.

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Appendix

In Appendix A, we provide additional analysis regarding the impact of the CEO and the successor on the firm's equity value, analyze their optimal departure policies, provide additional comparative statics results, and discuss several extensions and show our results are robust. In Appendix B, we present all the proofs. Appendix C contains the numerical implementation of the baseline model.

A Model Analysis

I CEO Ability and Equity Value

We first study how the CEO and the successor's expected abilities affect equity value. Proposition 5 shows that the firm's equity value is always higher when having a CEO or a successor with a higher expected ability.

Proposition 5 (Equity Value and CEO and Successor Expected Ability)**.** *The equity value $V(c,s)$ is (weakly) increasing in the CEO's expected ability c and in the successor's expected ability s.*

In our model, more able CEOs and successors allow the firm to generate higher cash flows, which increases the equity value. This result is consistent with existing empirical evidence documenting that CEO ability is positively related to equity value (Bertrand and Schoar, 2003; Bandiera et al., 2020; Bennedsen et al., 2020; Jenter et al., 2024). An additional prediction of our model is that equity value should also increase in the successor's expected ability. In our setup this happens even though the successor does not influence today's cash flows, but because the successor's ability can affect them in the future.

II Departures

We next focus on analyzing when executives depart from the firm. We establish that the CEO's departure policy has a threshold form. Proposition 6 shows that if the board wants to replace the CEO due to insufficient ability, then it will also replace any worse CEO.

Proposition 6 (CEO Departures)**.** *There exists a threshold $\underline{c}(s)$ such that the board (weakly) wants the CEO to leave if and only if $c \leq \underline{c}(s)$.*

$$V(c,s) = \max\{V(e,s) - K - \Phi, V(s,0) - K\} \quad \Leftrightarrow \quad \forall c \leq \underline{c}(s).$$

The successor's departure policy also has a threshold form. Similarly, Proposition 7 shows that if the board wants to replace the successor due to insufficient ability, then it will also replace any worse successor.

Proposition 7 (Successor Departures)**.** *There exists a threshold* $\underline{s}(c)$ *such that the board (weakly) wants the successor to leave if and only if* $s \leq \underline{s}(c)$*.*

$$V(c,s) = V(c,e) - \Phi \quad \Leftrightarrow \quad s \leq \underline{s}(c).$$

Figure A.1 presents these departure thresholds (for the parameter values as in Figure 2) and documents that the two departure thresholds—$\underline{s}(c)$ and $\underline{c}(s)$—effectively split the parameter space. In the upper part, above $\underline{s}(c)$ and $\underline{c}(s)$, the board does not reshuffle the management, while below it the board changes the firm's management either by replacing the CEO or the successor.

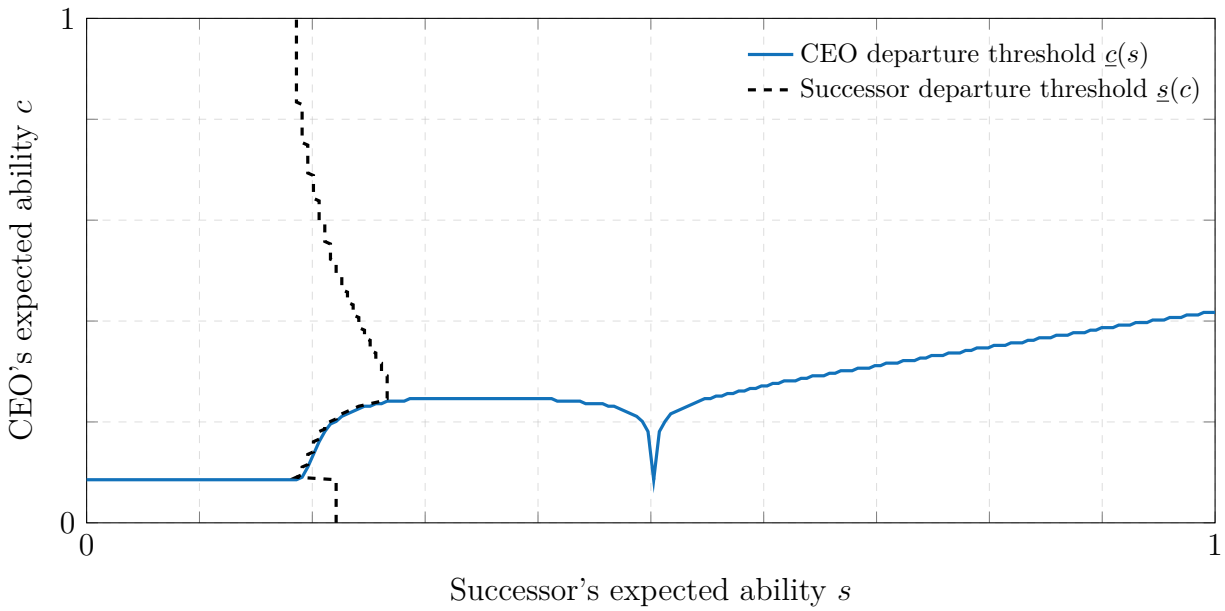


Figure A.1: **CEO and Successor Departure Thresholds**. The figure shows the CEO departure threshold $\underline{c}(s)$ and the successor departure threshold $\underline{s}(c)$ of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

III Robustness and Extensions

We now discuss several extensions of the model and analyze their impact on the results in Proposition 2 and Proposition 3.

Labor Market Equilibrium

Our framework could be embedded into a labor market equilibrium. In this case, external candidates' ability becomes a function of the model and labor market parameters L: $e^*(r, \lambda, \phi^c, \phi^s, K, \Phi, L) \in [0, 1]$. Propositions 2 and 3 hold true even in a labor market equilibrium in which the ability of the external candidates is endogenous $e^*(r, \lambda, \phi^c, \phi^s, K, \Phi, L) \in [0, 1]$. The reason is that both propositions do not depend on a specific value of the expected ability of external candidates e and therefore also hold for $e^*(r, \lambda, \phi^c, \phi^s = 0, K, \Phi > 0)$ in Proposition 2 and for $e^*(r, \lambda, \phi^c, \phi^s > 0, K, \Phi = 0, L)$ in Proposition 3.

Unknown Ability of External Candidates

We could allow for external candidates with different, ex ante unknown, expected abilities. Instead of a constant expected ability e, we could assume that the expected ability of external candidates is independently and identically distributed according to a probability density function $f(\cdot) > 0$ on the domain $[\underline{e}, \bar{e}]$, where $\bar{e} < 1$. Propositions 2 and 3 would still hold true in such a setting. In particular, with no learning about the successor, the firm would still have no incentives to hire a successor leading to only external successions. In the absence of labor market frictions, the board would repeatedly search for new external candidates until it finds one of the type $\bar{e}$, which would then be hired. The same arguments as before would then imply that the expected ability of the successor is better than the external candidate, $S_t \geq \bar{e}$, leading to only internal successions.

Learning About External Candidates

We could extend our model so that the board learns about the external candidates. The expected ability of external candidates could be time-varying e_t and follow a learning process similar to that of the CEO's and successor's expected ability, see Equation (1) and (2). When the board does not learn about the successor, $\phi^s = 0$, but does learn about the external candidates e_t, then the board might have an incentive to hire an external candidate with a high expected ability e_t as the successor and continue to learn about other external candidates. Doing so is costly, as it requires the firm to pay K today instead of in the future. This successor can then be promoted to CEO. Internal successions could thus also arise when the board learns about external candidates but not about the internal successor. In Proposition 3, the board compares the successor to the best external candidates and replaces the successor as soon as it finds a better external candidate. As a consequence, the successor in place always dominates any external candidate, $S_t \geq e_t$, and there are only internal successions.[19]

[19]The key assumption is that hiring on the executive labor market does not affect e_t. If it did, then the firm could have an incentive to delay hiring a successor to keep the current successor and the high-ability external candidate and as a consequence $e_t > S_t$. When there is a chance that this external candidate gets

Cash Flows Affected by Successor

We also analyze what happens if the successor affects the firm's cash flows, for example, if the firm's cash flows are given by $dX_t + \beta dY_t$ with $\beta \geq 0$. We assume that dX_t and dY_t are separately observable by the board so as not to complicate the learning problem. Proposition 3 is unaffected by this change as the expected ability of the successor S_t still dominates the expected ability of any external candidate e, $S_t \geq e$, which drives the internal successions. Proposition 2 remains valid as long as β is sufficiently small. A larger β increases the board's incentives to employ a successor since by not doing so the firm has to forgo expected cash flows $\mathbb{E}_t[\beta dY_t] \geq 0$. For low values of β, these forgone cash flows are small relative to the labor market search cost Φ and the board does not hire any successor and therefore all successions are external successions. For high values of β, the forgone cash flows dominate and the firm starts hiring successors, who might be promoted.

Human Capital

We could incorporate the notion of firm-specific human capital accumulation into the model by having low-ability CEOs and successors become high-ability with an exogenous intensity. This would make their expected ability drift upwards over time. Human capital accumulation would incentivize the board to hire a successor in Proposition 2, as it would generate benefits of having a successor and therefore would lead to internal successions. The result in Proposition 3 is not affected by human capital accumulation, as the expected ability of the successor S_t still dominates the expected ability of any external candidate e, $S_t \geq e$, which drives internal successions.

Strategic Change

Our framework could be extended to include the notion of strategic change, for instance by allowing the firm to be hit by an exogenous shock, which would require the board to change the firm's strategy and thus lower the CEO's and successor's fit with the company—their respective abilities. Such a strategic change would not affect the result in Proposition 2 as it would not generate any benefits of hiring a successor. However, external succession would become possible in Proposition 3, because a strategic change incentivizes the board to hire executives from the outside. Internal succession would still take place in case no strategic change happens.

Internal and External Labor Market

We can allow the board to search for executives on an internal labor market. That is, the board can look for a new candidate within the organization to become the new CEO or

poached by another firm then the firm might have incentives to employ two successors.

successor. These candidates would have an expected ability e^{int} and come at a cost Φ^{int}. Proposition 3 remains valid in the presence of the internal labor market (assuming $\Phi = \Phi^{int} = 0$), as the successor still dominates any internal or external candidate ($S_t \geq \max\{e, e^{int}\}$). However, internal successions can happen in Proposition 2, because the board could now prefer internal labor market candidates over external labor market ones. This happens, for example, if internal labor market candidates have a higher expected ability ($e^{int} > e$) while also being cheaper to hire ($\Phi^{int} < \Phi$).

IV Comparative Statics

This appendix shows additional comparative statics results with respect to the speed of learning about the CEO ϕ^c (Figure A.3), the CEO replacement cost K (Figure A.4), and the exogenous departure rate of CEOs λ (Figure A.2).

B Proofs

Given the result in Corollary 1, all proofs are carried out for the case $\mu = 0$ without loss of generality.

Proof of Proposition 5. Given the board's beliefs, we have that $dX_t = C_t dt + \frac{1}{\phi^c} dB_t^c$. Assume that $c' > c$. Given a sample path of $B_t^c(\omega)$, we have that for the current CEO $C_t'(\omega) > C_t(\omega)$.

Let $\tilde{V}(c', s)$ be the equity value when the board acts as if the current CEO only has prior expected ability c instead of c'. Under this policy, the cash flows of $\tilde{V}(c', s)$ and $V(c, s)$ are the same except for the ones generated by the current CEO, which are strictly higher since $C_t'(\omega) > C_t(\omega)$. As a consequence,

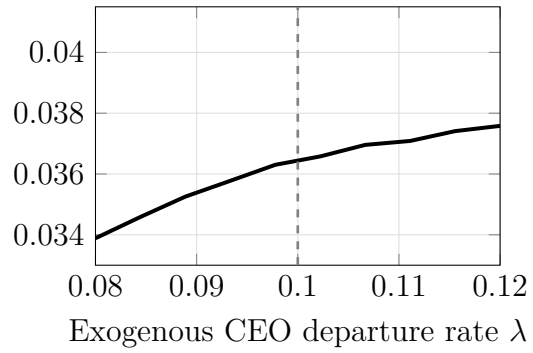
$$V(c, s) \leq \tilde{V}(c', s) \leq V(c', s),$$

where the first inequality follows from the fact that all future expected cash flows are weakly larger if the current CEO has expected ability $c' > c$, and the second inequality is due the fact that the board's optimal policies maximize the equity value.

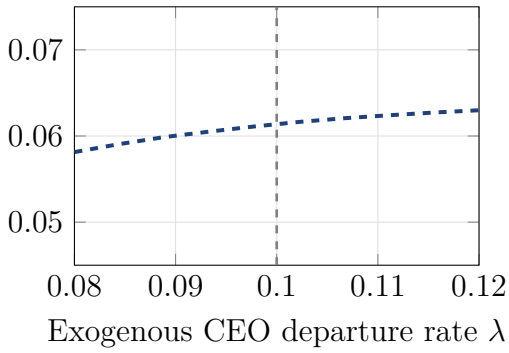
Similar arguments as above imply that when $s' > s$, then $V(c, s) \leq V(c, s')$. □

Proof of Proposition 6. Given s, if the CEO does not depart for any $c \in [0, 1]$, then $\underline{c}(s) < 0$ and we are done. Otherwise, let $\underline{c}(s) \geq 0$ be the largest value of c such that the CEO departs. We know that $V(c, s) \geq \max\{V(e, s) - \Phi - K, V(s, 0) - K\}$ because the board maximizes the equity value.

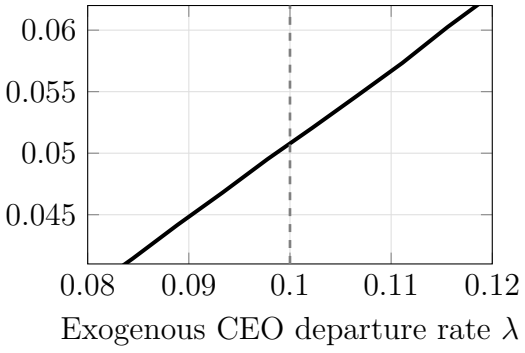
Assume the result is not true. In this case there would exist a $c < \underline{c}(s)$ such that $V(c, s) > \max\{V(e, s) - \Phi - K, V(s, 0) - K\} = V(\underline{c}(s), s)$, which contradicts the fact that



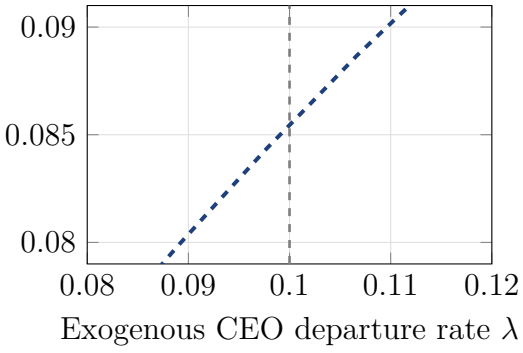
(a) Endogenous CEO departure rate



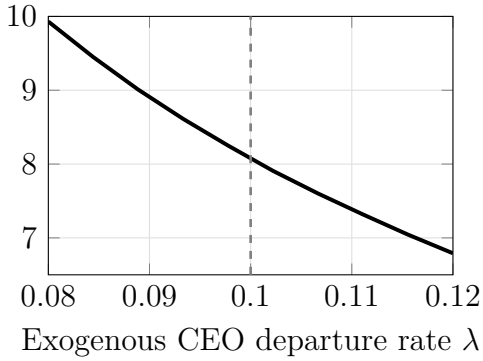
(b) Successor departure rate



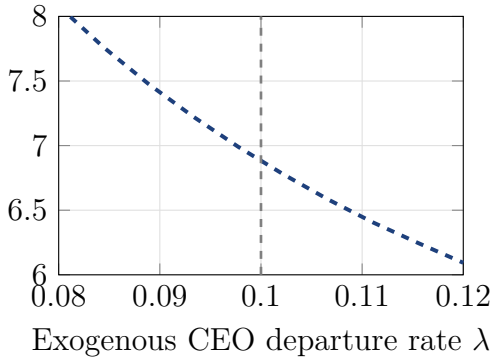
(c) External succession rate



(d) Internal succession rate

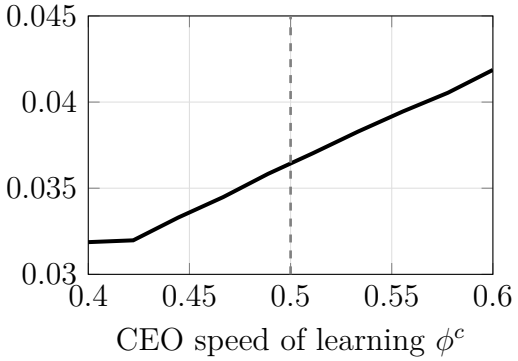


(e) CEO tenure

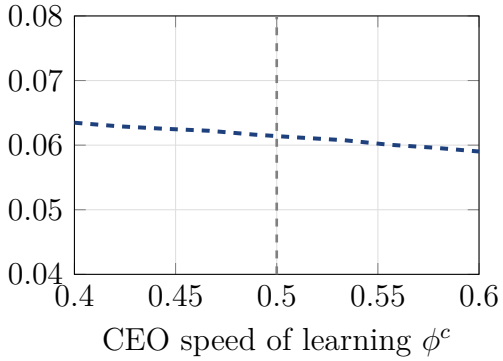


(f) Successor tenure

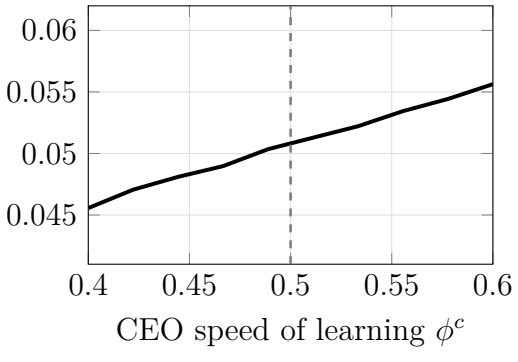
Figure A.2: **Effect of Exogenous CEO Departure Rate λ.** This figure shows the effect of the exogenous CEO departure rate λ on CEO and successor departure rates, external and internal succession rates, as well as CEO and successor tenure. The baseline parameter values are $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$.



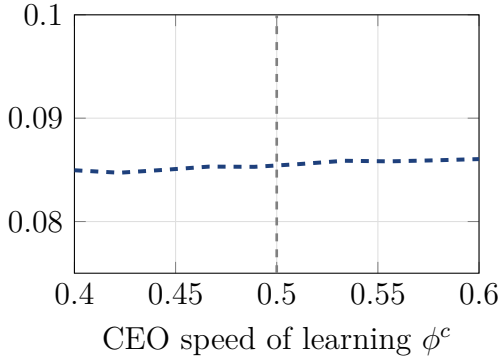
(a) Endogenous CEO departure rate



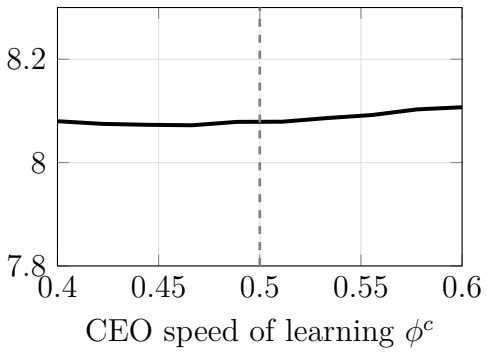
(b) Successor departure rate



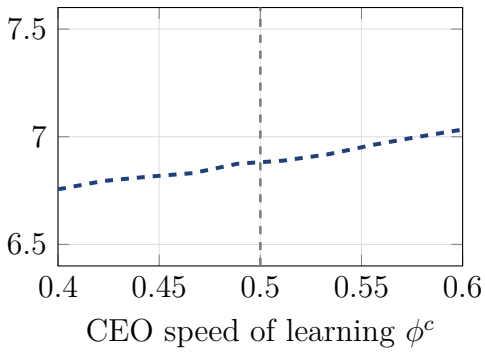
(c) External succession rate



(d) Internal succession rate

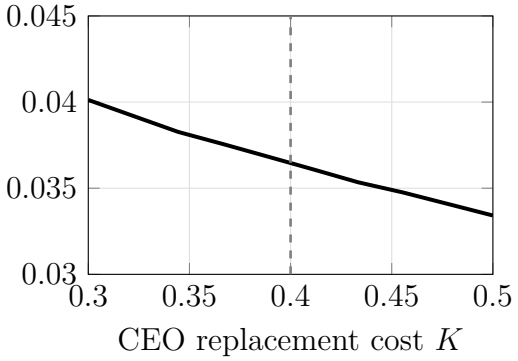


(e) CEO tenure

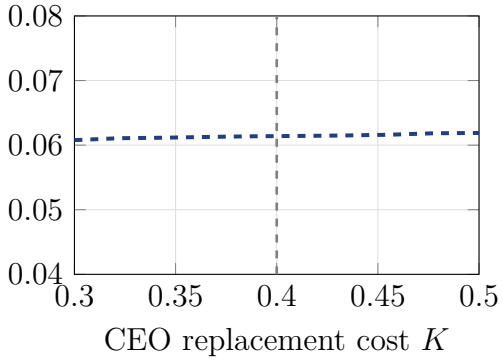


(f) Successor tenure

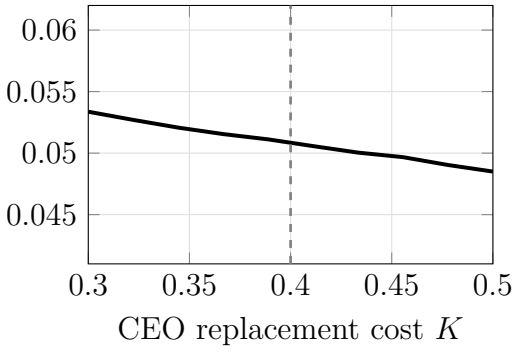
Figure A.3: **Effect of CEO Speed of Learning ϕ^c.** This figure shows the effect of CEO speed of learning ϕ^c on CEO and successor departure rates, external and internal succession rates, as well as CEO and successor tenure. The baseline parameter values are $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$.



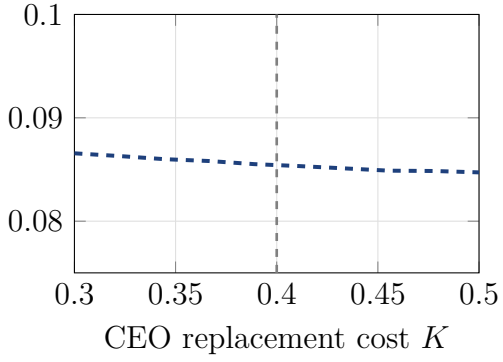
(a) Endogenous CEO departure rate



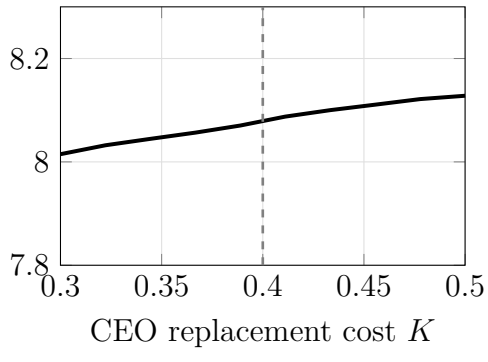
(b) Successor departure rate



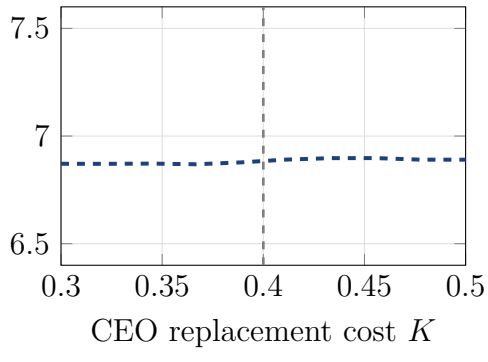
(c) External succession rate



(d) Internal succession rate



(e) CEO tenure



(f) Successor tenure

Figure A.4: **Effect of CEO Replacement Cost K.** This figure shows the effect of the new CEO replacement cost K on CEO and successor departure rates, external and internal succession rates, as well as CEO and successor tenure. The baseline parameter values are $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$.

the equity value is weakly increasing in c (Proposition 5).[20] □

Proof of Proposition 7. Given c, if the successor does not depart for any $s \in [0,1]$, then $\underline{s}(c) < 0$ and we are done. Otherwise, let $\underline{s}(c) \geq 0$ be the largest value of s such that the successor departs. We know that $V(c,s) \geq V(c,e) - \Phi$ because the board maximizes the equity value.

Assume the result is not true. In this case, there would exist an $s < \underline{s}(c)$ such that $V(c,s) > V(c,e) - \Phi = V(c,\underline{s}(c))$, which contradicts the fact that the equity value is weakly increasing in s (Proposition 5). □

Proof of Proposition 1. Let $\tilde{V}(0,s)$ be the equity value when the board acts as if the current CEO is of expected ability c instead of 0. The difference in cash flows between $V(c,s)$ and $\tilde{V}(0,s)$ is

$$\left(C_t dt + \frac{1}{\phi^c} dB_t^c\right) - \left(0 + \frac{1}{\phi^c} dB_t^c\right) = C_t dt \geq 0$$

for as long as the current CEO is employed. Therefore,

$$\frac{c}{r+\lambda} = \mathbb{E}_{c,s}\left[\int_0^{\tau_\lambda} e^{-rt} c dt\right] = \mathbb{E}_{c,s}\left[\int_0^{\tau_\lambda} e^{-rt} C_t dt\right] \geq V(c,s) - \tilde{V}(0,s) \geq V(c,s) - V(0,s). \quad \text{(A.1)}$$

The second equality follows from the fact that C_t is a martingale. The first inequality results from the difference in cash flows between $V(c,s)$ and $\tilde{V}(0,s)$ and the fact that the current CEO is employed for at most τ_λ. The second inequality follows because $V(0,s)$ maximizes equity value under the optimal policy for state $(0,s)$, whereas $\tilde{V}(0,s)$ applies the suboptimal policy designed for state (c,s). Therefore $V(0,s) \geq \tilde{V}(0,s)$.

Assume $K > \tilde{K}(s) = \frac{\max\{e,s\}}{r+\lambda}$. Then, from equation (A.1), Proposition 5, and the fact that $\Phi \geq 0$, it follows that

$$\begin{aligned} V(s,0) - K \leq V(s,s) - K < V(0,s), \\ V(e,s) - K - \Phi \leq V(e,s) - K < V(0,s). \end{aligned}$$

Therefore, the board has no incentive to either promote the current successor or hire an external candidate to become the CEO when $K > \tilde{K}(s)$ and $\tilde{K}'(s) \geq 0$. Thus, it directly follows that the function $\bar{K}(s)$ exists. □

Proof of Proposition 2. We want to show that it is suboptimal for the board to hire a successor given that the firm has no successor today, which guarantees that all successions are external successions.

[20] Observe that the board would never strictly prefer to dismiss the CEO without replacement, as the expected cash flows the CEO generates are non-negative $C_t dt \geq 0$.

Given that $\phi^s = 0$, there is no learning about the successor's ability and therefore the successor's expected ability remains at s.

Assume the firm has no current successor $s = 0$ and the current CEO is of expected ability $c \geq 0$. The equity value is $V(c, 0)$. Suppose that it is optimal for the board to hire an external candidate today to become the successor. This implies that $V(c, 0) = V(c, e) - \Phi$.

Proposition 6 implies that the CEO gets replaced as soon as $C_t \leq \underline{c}(e)$. There are two cases.

1. $c \leq \underline{c}(e)$. In this case, the board (weakly) prefers to replace the CEO and therefore $V(c, e) = \max\{V(e, 0) - K, V(e, e) - \Phi - K\}$. There are now two situations.

   (a) $V(c, e) = V(e, 0) - K$ and therefore $V(c, 0) = V(e, 0) - K - \Phi$, which implies that the board directly hires the external candidate to become CEO and therefore does not actually employ a successor.

   (b) $V(c, e) = V(e, e) - \Phi - K$ and therefore $V(c, 0) = V(e, e) - 2\Phi - K$, which implies that the board directly hires two external candidates, one to become the CEO and the other to become the successor. Given that the ordering of hiring the external candidates is irrelevant,

   $$V(e, e) - \Phi = V(e, 0).$$

   since $V(e, e) - \Phi \leq V(e, 0)$ because the board can always hire a new successor and $V(e, e) - \Phi \geq V(e, 0)$ since $V(c, e) = V(e, e) - \Phi - K \geq V(e, 0) - K$. Suppose that $e \leq \underline{c}(e)$, then it would be (weakly) optimal for the board to replace the CEO

   $$V(e, e) = \max\{V(e, 0) - K, V(e, e) - K - \Phi\} = V(e, e) - K - \Phi,$$

   which cannot be true as $K \geq 0$ and $\Phi > 0$. Therefore, $e > \underline{c}(e)$.

   Let $\tau_C = \inf\{t > 0 | C_t \leq \underline{c}(e)\}$ be the time at which the CEO gets replaced for endogenous reasons. The CEO can also leave for exogenous reasons at τ_λ. After the CEO departs (at either τ_C or τ_λ), but before any other actions are taken, the equity value is $V(0, e)$. The following inequalities then hold true

   $$\begin{aligned} V(e, 0) &= V(e, e) - \Phi \\ &= \mathbb{E}_{e,e}\left[\int_0^{\min\{\tau_C, \tau_\lambda\}} e^{-rt} dX_t + e^{-r\min\{\tau_C, \tau_\lambda\}} V(0, e)\right] - \Phi \\ &< \mathbb{E}_{e,e}\left[\int_0^{\min\{\tau_C, \tau_\lambda\}} e^{-rt} dX_t + e^{-r\min\{\tau_C, \tau_\lambda\}} (V(0, e) - \Phi)\right]. \end{aligned}$$

The first equality follows from the fact that hiring a successor today is optimal and the second equality results from the expected cash flows the firm receives until $\min\{\tau_C, \tau_\lambda\}$. The inequality is due to the fact that $\Phi > 0$, $r > 0$, and $\min\{\tau_C, \tau_\lambda\} > 0$. But this inequality implies that delaying hiring the successor until $\min\{\tau_C, \tau_\lambda\}$ increases the equity value, which contradicts the optimality of hiring a successor today.

2. $c > \underline{c}(e)$. Let $\tau_C = \inf\{t > 0 | C_t \leq \underline{c}(e)\}$ be the time at which the CEO gets replaced for endogenous reasons. The CEO can also leave for exogenous reasons at τ_λ. After the CEO departs (at either τ_C or τ_λ), but before any other actions are taken, the equity value is $V(0, e)$. The following inequalities then hold true

$$\begin{aligned} V(c,0) &= V(c,e) - \Phi \\ &= \mathbb{E}_{c,e}\left[\int_0^{\min\{\tau_C,\tau_\lambda\}} e^{-rt} dX_t + e^{-r\min\{\tau_C,\tau_\lambda\}} V(0,e)\right] - \Phi \\ &< \mathbb{E}_{c,e}\left[\int_0^{\min\{\tau_C,\tau_\lambda\}} e^{-rt} dX_t + e^{-r\min\{\tau_C,\tau_\lambda\}} (V(0,e) - \Phi)\right]. \end{aligned}$$

The first equality follows from the fact that hiring a successor today is optimal and the second equality follows from the expected cash flows the firm receives until $\min\{\tau_C, \tau_\lambda\}$. The inequality is due to the fact that $\Phi > 0$, $r > 0$, and $\min\{\tau_C, \tau_\lambda\} > 0$. But this inequality implies that delaying hiring the successor until $\min\{\tau_C, \tau_\lambda\}$ increases the equity value, which contradicts the optimality of hiring a successor today.

The board will thus optimally never hire (and therefore promote) a successor and as a consequence all successions are external. □

Proof of Proposition 3. See footnote 13 for additional assumptions. From Proposition 5 it follows that $\frac{\partial V(c,s)}{\partial s} \geq 0$. As a consequence, for any $s \leq e$, $V(c,s) - \Phi = V(c,s) \leq V(c,e)$ and therefore the board replaces the successor as soon as $s \leq e$. As a result, the successor is of expected ability $s \geq e$.

For $s > e$, if it is ever (strictly) optimal to hire an external CEO, then it must be that $V(s,e) < V(e,s)$, but since $s > e$ and $c_1 \geq c_2 \Rightarrow V(c_1, c_2) \geq V(c_2, c_1)$, then it cannot be true. Therefore, there are only internal successions for $s > e$.

At $s = e$, the board replaces the CEO with the successor who is of type $s = e$ as no news has arrived yet about the successor before the CEO replacement decision is made, see the assumption about timing at each time t in footnote 13. Therefore, at $s = e$ only internal successions take place. □

Proof of Proposition 4. The Hamilton-Jacobi-Bellman (HJB) equation if the board would

delay any management reshuffle is given by

$$0 = \max_{\phi^s \geq 0} \Bigg\{ -rV(c,s) + c + \frac{1}{2}\left(\phi^c\right)^2 c^2(1-c)^2 \frac{\partial^2 V(c,s)}{\partial c^2} + \frac{1}{2}\left(\phi^s\right)^2 s^2(1-s)^2 \frac{\partial^2 V(c,s)}{\partial s^2} \\ - L(\phi^s)^4 + \lambda(V(0,s) - V(c,s)) \Bigg\}. \tag{A.2}$$

Let $\Phi^s = \left(\phi^s\right)^2$, differentiating (A.2) with respect to Φ^s yields

$$\frac{1}{2}s^2(1-s)^2 \frac{\partial^2 V(c,s)}{\partial s^2} - 2L\Phi^s.$$

This first-order condition is non-positive when $\frac{\partial^2 V(c,s)}{\partial s^2} < 0$ and therefore in this case quadratic speed of learning is $\Phi^{s*}(c,s) = 0$, which implies $\phi^{s*}(c,s) = 0$. If $\frac{\partial^2 V(c,s)}{\partial s^2} > 0$ then the optimal quadratic speed of learning is

$$\Phi^{s*}(c,s) = \frac{1}{4L}s^2(1-s)^2 \frac{\partial^2 V(c,s)}{\partial s^2}$$

and the speed of learning is

$$\phi^{s*}(c,s) = \sqrt{\Phi^{s*}(c,s)} = \frac{1}{2\sqrt{L}}s(1-s)\sqrt{\frac{\partial^2 V(c,s)}{\partial s^2}}.$$

The comparative statics follow from inspection of the formula. □

C Numerical Procedure

This appendix describes the numerical procedure used to calculate the equity value function for the baseline model (Section II).

The equity value function $V(c,s)$ satisfies the following Hamilton-Jacobi-Bellman (HJB)

equation

$$0 = \max\Bigg\{ -(r+\lambda)\,V(c,s) + c + \lambda V(0,s) + \frac{1}{2}\left(\phi^c\right)^2 c^2(1-c)^2\frac{\partial^2 V(c,s)}{\partial c^2} + \frac{1}{2}\left(\phi^s\right)^2 s^2(1-s)^2\frac{\partial^2 V(c,s)}{\partial s^2}, V(s,0) - K - V(c,s), V(s,e) - K - \Phi - V(c,s), V(c,e) - \Phi - V(c,s), V(e,s) - K - \Phi - V(c,s), V(e,e) - K - 2\Phi - V(c,s)\Bigg\}.$$

We try to find a solution for this HJB equation iteratively.

We first discretize the state space $(s,c) \in [0,1]^2$. We use n equally-spaced discrete points along each dimension so our discretized state space has n^2 points: $\{s_1, ..., s_n\}$ and $\{c_1, ..., c_n\}$ with $s_1 = c_1 = 0$ and $s_n = c_n = 1$.

Start with an initial guess $V_0(c,s)$. Given $V_t(c,s)$, we then want to determine the next iteration $V_{t+\Delta_t}(c,s)$. If we keep on iterating, then $\lim_{t\to\infty} V_t(c,s)$ should solve the HJB equation.

First, we loop over $c \in \{c_1, ..., c_n\}$. For each c, we solve the differential equation that is part of the HJB equation treating the term containing the second-order derivative with respect to c as given. More precisely, we use a finite difference scheme that is implicit in the s-dimension and explicit in the c-dimension with a false transient (an artificial time-derivative) (Hansen et al., 2018; Kaplan et al., 2020). Our updating equation looks as follows

$$V_{t+\Delta_t}(c,s) \approx V_t(c,s) + \Delta_t\Bigg\{ -(r+\lambda)\,V_{t+\Delta_t}(c,s) + c + \lambda V_t(0,s) + \frac{1}{2}\left(\phi^c\right)^2 c^2(1-c)^2\frac{\partial^2 V_t(c,s)}{\partial c^2} + \frac{1}{2}\left(\phi^s\right)^2 s^2(1-s)^2\frac{\partial^2 V_{t+\Delta_t}(c,s)}{\partial s^2}\Bigg\},$$

where Δ_t is set sufficiently small to ensure convergence.

Given the discretized state space, we can write this updating equation as

$$
\begin{aligned}
&A^c V_{t+\Delta_t}(c,:) = B_t^c, \qquad \text{(A.3)}\\
&B_t^c = V_t(c,:) + \Delta_t \left(c + \lambda V_t(0,:) + \frac{1}{2} \left(\phi^c\right)^2 c^2 (1-c)^2 \frac{\partial^2 V_t(c,:)}{\partial c^2} \right),\\
&A^c = I \left(1 + \Delta_t \left(r + \lambda\right)\right) - \Delta_t M,\\
&M_{i,i} = -\frac{\left(\phi^s\right)^2 s_i^2 (1-s_i)^2}{\Delta_s^2},\\
&M_{i,i\pm 1} = \frac{\left(\phi^s\right)^2 s_i^2 (1-s_i)^2}{2\Delta_s^2},
\end{aligned}
$$

where I is the identity matrix and $\Delta_s = s_2 - s_1$ is the step size of the grid of s. The other elements of M are zero. We calculate the second-order derivative with respect to c using neighboring grid points

$$
\frac{\partial^2 V_t(c,s)}{\partial c^2} = \frac{V_t(c_{j-1},s) - 2V_t(c_j,s) + V_t(c_{j+1},s)}{\Delta_c^2},
$$

where $\Delta_c = c_2 - c_1$ is the step size of the grid of c. At the boundaries of the state space $c, s \in \{0,1\}$, we do not need to calculate the second-order derivatives since $\frac{1}{2}\left(\phi^s\right)^2 s^2 (1-s)^2 = 0$ for $s \in \{0,1\}$ and $\frac{1}{2}\left(\phi^c\right)^2 c^2 (1-c)^2 = 0$ for $c \in \{0,1\}$ and therefore we set the term with second-order derivatives equal to zero. Equation (A.3) is a system of n linear equations with n unknowns, which we can solve and has as solution $\hat{V}_{t+\Delta_t}(c,:)$.

Given this solution, we determine for every $s \in \{s_1, ..., s_n\}$ if the firm is better off changing management or delaying this change

$$
\begin{aligned}
V_{t+\Delta_t}(c,s) = \max \Big\{ &\hat{V}_{t+\Delta_t}(c,s), V_t(s,0) - K, V_t(s,e) - K - \Phi,\\
&V_t(c,e) - \Phi, V_t(e,s) - K - \Phi, V_t(e,e) - K - 2\Phi \Big\}.
\end{aligned}
$$

We repeat this procedure for every c after which we set $t = t + \Delta_t$. We keep on repeating this procedure until the average change in the equity value function,

$$
\frac{\sum_{c,s} \left| V_{t+\Delta_t}(c,s) - V_t(c,s) \right|}{n^2},
$$

is sufficiently small. For the model with endogenous learning (Section III), we gradually update $\phi^{s*}(c,s)$ every k-steps using the result in Proposition 4. The algorithm is summarized in the figure below.

Algorithm 1: Equity Value Function

`// Initialize`
$V_0(c, s)$
$t = 0$
$error > value_function_error_bound$

`// Loop to update the value function`
while $error > value_function_error_bound$ **do**

`// Loop over CEO's expected ability` c
for $c \in \{c_1, ..., c_n\}$ **do**

`// Determine updating equation`
Calculate M
$A^c = [(1 + \Delta_t (r + \lambda)) I - \Delta_t M]$
$B_t^c = V_t(c, :) + \Delta_t \left(c + \lambda V_t(0, :) + \frac{1}{2} (\phi^c)^2 c^2 (1 - c)^2 \frac{\partial^2 V_t(c,:)}{\partial c^2} \right)$

`// Solve for` $\hat{V}_{t+\Delta_t}(c, :)$
Solve $A^c \hat{V}_{t+\Delta_t}(c, :) = B_t^c$

`// Loop over successor's expected ability` s
for $s \in \{s_1, ..., s_n\}$ **do**

`// Management change`
$$V_{t+\Delta_t}(c, s) = \max \Big\{ \hat{V}_{t+\Delta_t}(c, s), V_t(s, 0) - K, V_t(s, e) - K - \Phi, V_t(c, e) - \Phi, V_t(e, s) - K - \Phi, V_t(e, e) - K - 2\Phi \Big\}.$$

end
end

`// Update error and time`
$error = \frac{\sum_{c,s} |V_{t+\Delta_t}(c,s) - V_t(c,s)|}{n^2}$
$t = t + \Delta_t$
end

`// Return results`
return $V_t(c, s)$ and $error$

D Simulation Procedure

This appendix describes the numerical procedure used to calculate simulated model moments. The simulation is based on the policy function $S(c, s)$, see Figure 2, that we obtained using the procedure in Appendix C. We discretize time into steps of size Δt and simulate n_{paths} sample paths over a time horizon T. The expected abilities of the CEO and successor evolve according to Equations (1) and (2), with management changes occurring based on the optimal policy. The function Transit$(\cdot)$ updates the state and tenure based on board actions (e.g., promoting successor resets CEO tenure), and calculateMoments$(\cdot)$ computes departure rates, succession rates, and average tenures from the simulated paths. We treat interim CEOs and successors as equal to more permanent appointees when calculating CEO and successor tenure. The algorithm is summarized in the figure below.

Algorithm 2: Simulation of Model

```
// Loop over paths
for path = 1 to n_paths do
    // Initialize variables for this path
    (c_{path,0}, s_{path,0}) = (e, e)
    tenure_{path,0} = (ceo_tenure_{path,0}, successor_tenure_{path,0}) = (0, 0)

    // Loop over time
    for t = 2 to n_steps do
        // Learning dynamics
        c_{path,t} = c_{path,t-1} + φ^c · c_{path,t-1} · (1 − c_{path,t-1}) · √Δt × randn()
        s_{path,t} = s_{path,t-1} + φ^s · s_{path,t-1} · (1 − s_{path,t-1}) · √Δt × randn()

        // Ensure beliefs remain in [0,1]
        c_{path,t} = max(0, min(1, c_{path,t}))
        s_{path,t} = max(0, min(1, s_{path,t}))

        // CEO and successor tenure
        tenure_{path,t} = tenure_{path,t-1} + Δt

        // Exogenous departure if it occurs
        exog_departure_{path,t} = (rand() < λ · Δt)
        if exog_departure_{path,t} then
            c_{path,t} = 0
            ceo_tenure_{path,t} = 0
        end

        // Management reshuffles (if they happen)
        // Get action/policy from solution matrix
        action_{path,t} = S(c_{path,t}, s_{path,t})
        // Transition state variables because of action
        (c_{path,t}, s_{path,t}, tenure_{path,t}) = Transit(action_{path,t}, c_{path,t}, s_{path,t}, tenure_{path,t})
    end
end

// Calculate moments from simulated paths
moments = calculateMoments(c, s, action, exog_departure, tenure)

// Return results
return c, s, action, moments
```