Succession*

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Abstract

Managing CEO succession is one of the board's most important tasks. We develop a dynamic model of CEO succession to analyze executive hiring, firing, and entrenchment. The board learns about the CEO's and successor's ability and can decide to replace the executives internally or externally. Our model explains the board's preference towards internal CEO successions, which become more likely with more efficient executive labor markets. We also demonstrate that the CEO's ability to sabotage the successor can make the CEO more entrenched but can also backfire and get the CEO fired.

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JEL Classifications: G30, G34, M12.

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CEOs have a long-lasting impact on firms they run (Bertrand and Schoar, 2003; Bandiera et al., 2020; Bennedsen et al., 2020; Jenter et al., 2021). Therefore, CEO hiring and succession planning are some of the most important responsibilities of the board of directors and the current CEO. It turns out, however, that in practice many firms have poor or no succession planning (Fernández-Aráoz et al., 2021; Cvijanović et al., 2022). At the same time, when successions do happen, as many as 80% of CEO successors are insiders (Cziraki and Jenter, 2022), even though frictionless labor market models predict that the best CEO should typically come from outside the firm.[1] This puzzling evidence raises the question: why do firms prefer hiring internal candidates and, more generally, what drives succession planning? In this paper, we develop a dynamic model of CEO succession, which allows us to study how firms hire and fire CEOs, how they set up their succession plans, and how these plans affect CEO entrenchment.

Our model provides several novel findings. First, we rationalize the empirical prevalence of internal successions documented by Parrino (1997), Huson et al. (2004), and Cziraki and Jenter (2022). Second, our model explains the apparent absence of succession planning within firms (Cvijanović et al., 2022; Larcker et al., 2022) and the extensive delays when appointing new CEOs (Rivolta, 2018; Gabarro et al., 2022). Third, we demonstrate that succession planning can foster managerial entrenchment but in certain cases it can also result in the CEO getting fired more easily. Overall, our model rationalizes several empirical succession patterns, derives new testable implications, and provides a novel channel for managerial entrenchment.

In the model, the firm employs a CEO and a successor, who could for example be the current COO or the president. Over time, the board learns about the CEO's and the successor's ability by following their work within the firm. The CEO's ability matters to

[1] In a frictionless labor market model such as Gabaix and Landier (2008) or Terviö (2008), the highest ability CEO a firm wants to attract resides outside the firm and is the CEO of a slightly smaller firm. Therefore, in these frictionless labor market models all new CEOs are hired from the outside.

the board as it directly affects the firm's cash flows. At any point in time, the board can decide to replace the CEO if they believe that she is not skilled enough, but doing so is costly. When appointing the new CEO, the board can either promote the successor—an *internal succession*—or engage in a costly search in the labor market to find an external candidate—an *external succession*.

When deciding on the new CEO appointment, the board compares the successor's expected ability to the expected ability of the external candidates. Consequently, if the board receives positive information about a successor, then the successor is more likely to become the new CEO. In contrast, when receiving negative information about the successor, the board is more inclined to hire an external candidate. Thus, learning about the successor's ability drives internal successions and helps explain the empirically observed willingness of firms to hire their CEOs from the inside (e.g., Cziraki and Jenter, 2022).

Internal successions are often associated with agency conflicts or managerial biases (e.g., Hermalin and Weisbach, 1998; He and Schroth, 2024). Our results show that this does not necessarily have to be the case. In particular, we show that a more efficient labor market for executives results in more internal successions. Less severe labor market frictions affect the firm in two ways. First, hiring external candidates becomes less costly, which increases the incidence of external successions. Second, replacing the successor is also less costly, which results in the firm employing successors of higher expected ability and therefore leads to more internal successions. Crucially, we show that the second effect dominates as the labor market becomes more efficient. Therefore, more efficient labor markets result in the board preferring to promote internally. One important implication of this result is that higher levels of internal successions may not be indicative of inefficiencies in the labor market for CEOs, as implied by the other theories, but may actually be driven by a more efficient labor market for executives.

Additionally, our results demonstrate that the apparent absence of succession planning (Cvijanović et al., 2022; Larcker et al., 2022) and the long delays in appointing new CEOs can sometimes be optimal for firms (Rivolta, 2018; Gabarro et al., 2022). This happens for two reasons. First, because it is expensive for firms to appoint, fire, or replace their CEOs. Second, because appointing a subpar CEO today is costly as it increases the effective cost of hiring a new CEO in the future. The reason is that the firm has to forgo future cash flows generated by this subpar CEO when letting her go. As a consequence, boards might endogenously delay appointing a new CEO until a suitable candidate is found, rather than hiring a subpar candidate today.

In practice, incumbent CEOs also play an important role in the succession process by, for example, mentoring successors (Bower, 2012; Berns and Klarner, 2017). While doing so, CEOs may not always have the shareholders' best interest in mind, however, and may even act to sabotage the successors to maintain their influence on the firm (Boeker, 1992; Cannella and Shen, 2001; Zhang, 2006). The sabotaging could, for example, come in the form of the CEO undermining the successor by refusing to collaborate or by spreading rumors. We extend the model by allowing the CEO to sabotage the successor. In our model the CEO is less likely to get replaced when sabotaging the successor. Thus, we propose a novel channel through which the CEO can become entrenched. We show that compensation plays a crucial role in determining the CEO's incentives to sabotage the successor. In particular, equity-based compensation lowers the CEO's incentives to sabotage the successor, because doing so negatively impacts the firm's equity value. On the other hand, fixed or profit-based compensation increases the CEO's incentives to sabotage the successor if sabotaging prolongs the CEO's tenure and therefore the value of compensation. As a consequence, more equity-based compensation decreases managerial entrenchment.

The board responds to the CEO sabotaging the successor in two ways.[2] First, the board changes the hiring policy. That is, the board optimally delays replacing a successor, because

[2]We are dealing with a dynamic game between the CEO and board (similar to DeMarzo and He, 2021) since the board anticipates that the CEO sabotaging the successor and the CEO anticipates the board's hiring and promotion policies.

it expects that the CEO will also sabotage the future successors, which lowers the board's incentives to hire any successor at all. This change in the hiring policy negatively impacts the successor's expected ability above and beyond the direct effect of the CEO's sabotage, which results in the CEO becoming even more entrenched. Second, the board changes the promotion policy. In particular, the board replaces the CEO with the successor more rapidly. This happens because the option value of delaying succession is lower due to the CEO sabotaging the successor. In response, the board replaces the CEO with the internal successor earlier. Trying to become entrenched can therefore backfire for the CEO since the board anticipates and optimally responds to the CEO's actions. We thus show that the CEO sabotaging the successor leads to managerial entrenchment and that the board's response can alleviate (via promotions) or exacerbate (via hiring) the managerial entrenchment. By doing so, we present a novel channel through which entrenchment can influence corporate policies.

Our paper contributes to several strands of the literature. First, we add to the theoretical literature on the market for CEOs (e.g., Murphy and Zabojnik, 2004; Tsoulouhas et al., 2007; Gabaix and Landier, 2008; Terviö, 2008; Eisfeldt and Kuhnen, 2013; Nickerson, 2013; Huang, 2016; Anderson et al., 2018; Chaigneau and Sahuguet, 2018, 2023). Most closely related are Hermalin (2005), Celentano and Mello (2023), and He and Schroth (2024). In Hermalin (2005), the board chooses whether to appoint an external or internal CEO with uncertain ability after which it can decide to learn about the CEO's ability and possibly replace her with a new CEO. However, there is no notion of succession planning, which is of key interest in our paper. Celentano and Mello (2023) and He and Schroth (2024) use a structural approach to quantify the cost and benefits of succession planning/hiring insiders versus outsiders. In contrast to these papers, we allow the board to select and learn about a successor, thereby microfounding the succession planning. One of our novel predictions is that less severe frictions in the labor market makes external successions less likely because lower frictions alter firms' hiring dynamics, which increases the likelihood of firms already employing a high-expected-ability successor. As a consequence, high levels of internal succession (e.g., Parrino, 1997; Cziraki and Jenter, 2022) may not necessarily be a sign of inefficiencies in the market for CEOs.[3,4]

Second, our paper contributes to the literature on managerial entrenchment. Existing models show that managerial entrenchment can be driven by investment, financing, boards of directors, compensation, or reputational concerns (e.g., Shleifer and Vishny, 1989; Zwiebel, 1996; Hermalin and Weisbach, 1998; Almazan and Suarez, 2003; Kuhnen and Zwiebel, 2008; Casamatta and Guembel, 2010). However, in our setup the CEO becomes more entrenched by sabotaging the successor. Most closely related to our work is Shleifer and Vishny (1989), who show that CEOs want to undertake actions that make them more valuable to the firm relative to possible successors, which leads to managerial entrenchment. Our model can be considered the flip side of Shleifer and Vishny (1989), in that in our setting the manager undertakes actions which make it harder for the successor to run the firm and increase the opportunity cost of hiring the successor.[5] We also show that the board optimally responds to the CEO's sabotage by delaying hiring a new successor, which fosters managerial entrenchment and speeds up promoting the successor, causing the CEO to get fired more easily.

Section I presents the baseline model. Section II analyses this baseline model and derives the main results. Section III extends the model to allow for sabotage, which leads to managerial entrenchment. Section IV concludes. Appendix A contains additional model analysis, all proofs are in Appendix B, and Appendix C describes the numerical algorithm

[3]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). In contrast to this literature, we study the dynamics of external hires versus internal promotions and how the existing CEO can sabotage internal promotions thereby becoming more entrenched. See Lazear and Oyer (2007), Waldman (2013), or Oyer and Schaefer (2011) for surveys of the personnel economics literature.

[4]See Berns and Klarner (2017) for a review of the CEO succession literature in management.

[5]There also exists a related theoretical literature in economics that studies sabotage (e.g., Salop and Scheffman, 1983; Lazear, 1989; Chen, 2003, 2005). Unlike this literature, we study the CEO's incentives to sabotage their subordinates (the successor) and the corresponding response by the firm. See Chowdhury and Gürtler (2015) for a survey of the literature on sabotage in contests.

used to solve the model.

I Model

In this section, we develop a dynamic model of CEO succession. Time t is continuous. There exists an infinitely-lived firm owned by risk-neutral shareholders who discount cash flows at rate $r > 0$. The firm is run by a board so as to maximize shareholders' equity value. The firm can employ a CEO and a successor. The board can decide to replace the CEO by the successor or by an external candidate. This process repeats itself over time, which allows us to study the succession of current and future CEOs within the firm. In Section III, we discuss in more detail the role of the CEO in the succession process.

A CEO

At time zero, the firm employs a CEO whose ability is θ^c, which can be either low or high $\theta^c \in \{L, H\}$ where $L = 0$ and $H = 1$. The CEO's ability, which can be interpreted as the fit with the firm, is unknown to the board, which has a prior $c \in [0, 1]$ about it being high.[6] The firm generates cash flows dX_t, which 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, $\phi^c \geq 0$ is the "speed" of learning about the CEO's ability, and $\tilde{B}_t^c$ is a standard Brownian motion. Higher speed of learning ϕ^c implies that cash flows dX_t are less noisy and therefore more informative about the CEO's ability. A higher cash flow level μ implies that the CEO's ability is relatively less important for the firm's cash flows.

[6] In the baseline model, only the board undertakes actions and therefore it does not matter what the CEO and successor know. In the extension in Section III, the CEO also undertakes actions.

The board updates its beliefs about the CEO's ability by observing the cash flows dX_t. Let $C_t = \mathbb{E}_t[\theta^c]$ be the CEO's expected ability given the information the board has acquired 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. (2023), 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, that is, less noisy 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 information is required to change beliefs.

Given the boards beliefs, the CEO's expected ability C_t thus directly impacts the firm's perceived 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.

While compensation plays an important role in generating the right incentives for executives (Edmans et al., 2017b), we do not endogenize the CEO's (or successor's) compensation to keep our model tractable and focus on the board's optimal succession policy (similar to, e.g., Taylor, 2010; He and Schroth, 2024).

B Successor

The firm can also employ a successor. The successor could, for example, be the firm's current COO or CFO.[7] The successor's ability is captured by θ^s, which can be either low or high $\theta^s \in \{0, 1\}$. The successor's ability is unknown to the board, which has a prior $s \in [0, 1]$ about it being high. Over time, the board receives news Y_t about the successor's ability by observing the successor's work (Harris and Holmstrom, 1982). The dynamics of the news are

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

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 $\tilde{B}_t^c$. As before, this setup implies that the dynamics of the successor's expected ability given the information the board has acquired 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.[8]

[7] Larcker and Tayan (2022) report that prior to becoming the CEO, the executive was 33% of the time a president/divisional, 27% of the time a COO, and 9% of the time a CFO.

[8] We could extend the model by allowing the dynamics of C_t (Equation (1)) and S_t (Equation (2)) to be correlated. Doing so would not fundamentally alter the underlying economic trade-offs. Solving the full filtering problem for the case in which the signals dX_t and dY_t are correlated is outside the scope of this paper.

C Succession

CEOs can depart for exogenous reasons (e.g., related to death as in Nguyen and Nielsen (2014) or Bennedsen et al. (2020)) and endogenous reasons (e.g., due to bad performance as in Jenter and Lewellen, 2021). Thus, we assume that the CEO's contract can be terminated either exogenously, which happens with intensity $\lambda \geq 0$, or endogenously, when the board decides to replace the CEO.[9]

If the board decides to replace the CEO with the successor then it incurs a replacement cost $K > 0$ as in Taylor (2010). The total cost of replacing a CEO includes direct costs such as deferred compensation or golden parachutes and indirect costs, for example stock price pressure or personnel turnover. Taylor (2010) and Nickerson (2013) provide evidence that the cost of replacing a CEO is significant and amounts to roughly 1.33% and 2.18% of firms' assets, respectively. Let τ_R be the time at which the board replaces the CEO with a successor whose expected ability is $S_{\tau_R^-}$ where $t^- = \lim_{s \uparrow t} s$ indicates the left limit of t. As soon as this happens, cash flows dX_t start depending on the successor's ability, which is high with probability $S_{\tau_R^-}$. The board thus performs due diligence on the successor before replacing the CEO, which can be seen as a *real option* (Daley et al., 2023).

The board can also search for external candidates on the executive labor market to replace either the CEO or the successor. However, engaging in the search process is costly as it requires incurring a fixed cost $\Phi \geq 0$. In practice, firms bear search costs by hiring an executive search firm (Khurana, 2000) or offering sign-on bonuses (Xu and Yang, 2016). The next time the board searches for an external candidate is at the time τ_E. When engaging in the external search, the board meets an external candidate. The external candidate's ability can be low or high, $\theta^e \in \{0, 1\}$ and is unknown to the board. The expected ability of all external candidates is $e \in [0, 1]$, which is also the probability that the candidate has

[9] We could incorporate poaching of the successor by competitors in a similar way. In such a setting, the successor would leave with a Poisson intensity which would also depend on the CEO's and successor's abilities.

a high ability. To keep the model tractable, we assume that expected ability of all external candidates is ex ante known. In Subsection II.C, we discuss what happens to our results in a setting where the expected ability of an external candidate is unknown ex ante and randomly drawn or when there is learning about the external candidates ability.

In sum, when engaging in the external search, the board incurs the search cost Φ and then meets an external candidate with expected ability e, which gives the board two options. First, it can decide to replace the CEO with the external candidate at a cost K. In this case, the firm's cash flows start depending on the external candidate's ability. Second, the board can replace the current successor with the external candidate at no additional cost. In this case, the news about the successor start depending on the external candidate's ability. Consistent with our model, Fee and Hadlock (2004) find that "*firms continually update their assessments of their non-CEO senior executive personnel and regularly remove suboptimal managers*". Given that the expected ability of the external candidate e is known, the board has no incentives to incur the search cost and not hire the external candidate. As the firm can replace its CEO and successor multiple times, we are dealing with an infinitely repeated real option problem (e.g., Fischer et al., 1989; Mauer and Ott, 1995; Hugonnier et al., 2015).[10]

Figure 1 plots the possible management reshuffles in the model. Given a CEO with expected ability C_t and a successor with expected ability S_t, the firm generates cash flows $dX_t = (\mu + C_t)\,dt + \frac{1}{\phi^c} dB_t^c$ and news $dY_t = S_t dt + \frac{1}{\phi^s} dB_t^s$. If the CEO leaves for exogenous reasons τ_λ or endogenous reasons τ_R and the board does not search for an external candidate $\tau_\lambda \wedge \tau_R < \tau_E$ then the board has two options:

1. The board can promote the successor to become the CEO, which requires a fixed cost K. In this case the firm's cash flows become $dX_\tau = (\mu + S_{\tau^-})dt + \frac{1}{\phi^c} dB_\tau^c$ where

[10] We can extend the model to also include an internal labor market. That is, the board could search for a new internal candidate to become the new CEO or successor. These candidates would have an expected ability e^{int} and come at a cost Φ^{int}. To keep the model parsimonious, we only focus on the case with an executive labor market. Furthermore, the main result (Proposition 3) would still go through in the presence of this internal labor market.

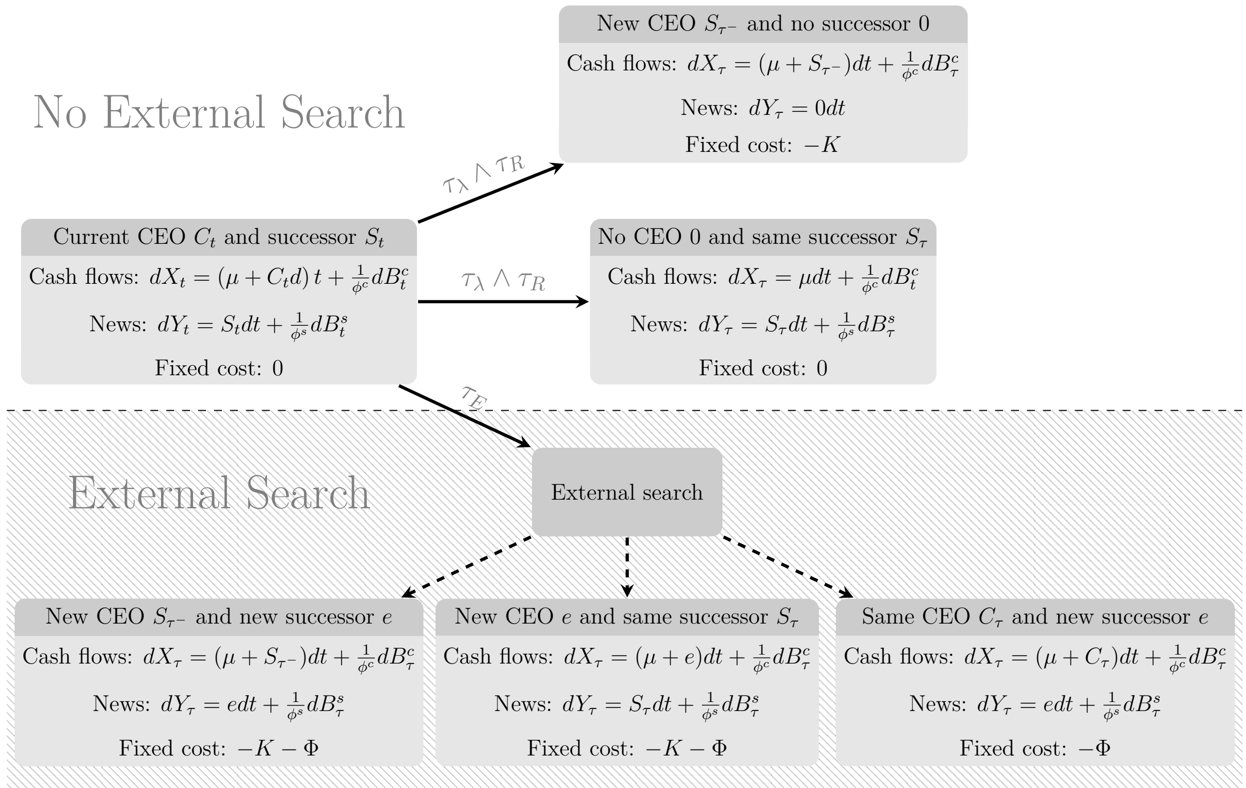

Figure 1: **Management Reshuffles.** The figure describes all possible transition dynamics within the management, including the new cash flows and news that the firm generates given the board's beliefs and possible fixed costs of hiring and search it incurs. $\tau_\lambda \wedge \tau_R = \min\{\tau_\lambda,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

$\tau = \min\{\tau_\lambda, \tau_R, \tau_E\}$ and there is no news $dY_\tau = 0dt$.

2. The board can decide not to appoint any CEO. In this case, the firm generates cash flows $dX_t = \mu dt + \frac{1}{\phi^c}dB^c_t$ 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, there are three possible scenarios:

1. The board replaces the current CEO by the external candidate, which results in cash flows becoming $dX_\tau = (\mu + e)dt + \frac{1}{\phi^c}dB^c_\tau$, the news remaining $dY_\tau = S_\tau dt + \frac{1}{\phi^s}dB^s_\tau$, and the firm incurring the replacement cost K.

2. The board, at the same time, replaces the CEO by the successor and appoints the external candidate as the new successor. In this case, 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 also incurs the replacement cost K.

3. The board replaces 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

Our setup implies that the equity value $V(c, s)$ depends on both the expected ability of the CEO, c, and that of 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 $\tau = \min\{\tau_\lambda, \tau_R, \tau_E\}$, then the equity value is

$$V(c,s) = \sup_{\tau_R,\tau_E} \Bigg\{ \mathbb{E}_{c,s} \left[\int_0^\tau e^{-rt} dX_t + \mathbb{I}_{\{\tau<\tau_E\}} e^{-r\tau} \max\{V(S_{\tau^-}, 0) - K, V(0, S_\tau)\} \right] \\ + \mathbb{E}_{c,s} \left[\mathbb{I}_{\{\tau=\tau_E\}} e^{-r\tau} \left(\max\{V(e, S_\tau) - K, V(S_{\tau^-}, e) - K, V(C_\tau, e)\} - \Phi \right) \right] \Bigg\}, \tag{3}$$

where the operator $\mathbb{E}_{c,s}[\cdot]$ denotes an expectation given the board's beliefs conditional on employing a CEO with initial expected ability c and a successor with initial expected ability s. The board selects the CEO replacement strategy τ_R and external search strategy τ_E to maximize the equity value. The first term 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 possibilities are also summarized in the external search part of Figure 1.

From the equity value and the cash flows dX_t it follows that the firm always generates a cash flow μdt, which is independent of the ability of the CEO. As a consequence,

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 Ability Dynamics

Figure 2 describes the different actions taken by the board depending on the state variables (c, s). Specifically, there are five different regions of the state space. *i*) In the white region, the board does not undertake any action and the current CEO and successor continue running the firm. The CEO and successor are of sufficient expected ability so that the board has no incentive to replace either. *ii*) In the blue region, the successor gets promoted to CEO and a new successor gets appointed. The successor is significantly better than the CEO and therefore the board decides to replace the CEO with its successor. The board then fills the vacant successor position by an external candidate. *iii*) In the light red region, a new external CEO gets appointed. The outside candidates dominate the CEO and the successor. Therefore, the CEO gets replaced by an external candidate. *iv*) In the dark red region, both the CEO and the successor are replaced by external candidates, since the board believes that their expected ability is insufficient. *v*) In the gray region, a new successor gets appointed. The successor is sufficiently worse than the external candidates and therefore is replaced by the board.

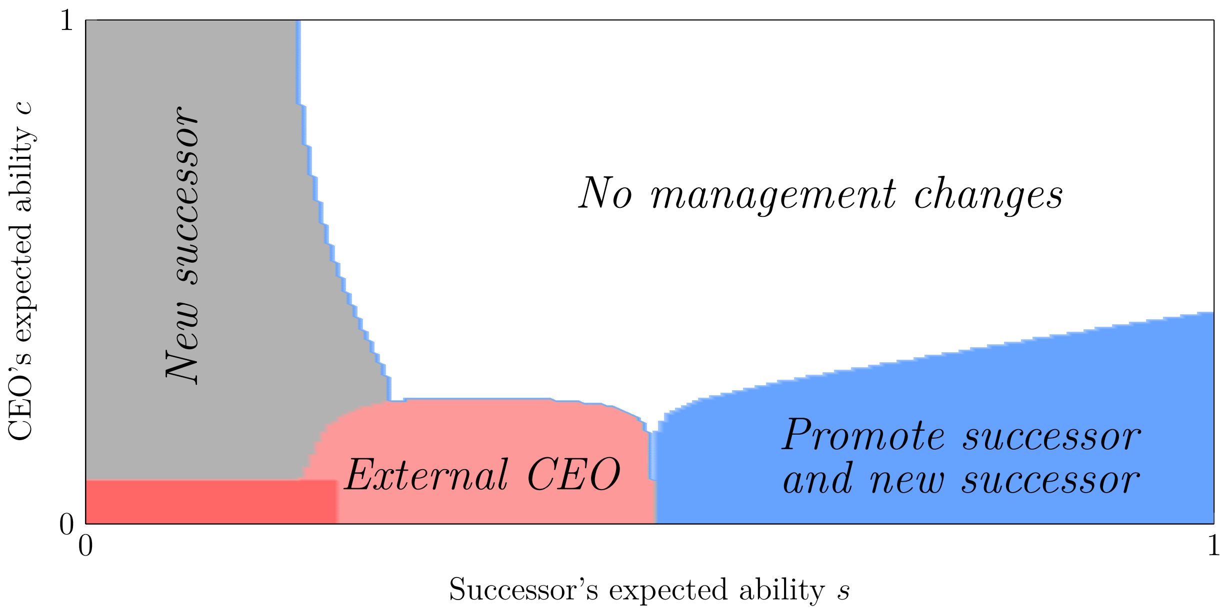

Figure 2: **Optimal Succession Policy**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

We provide more intuition by further illustrating the dynamics of CEO and successor expected ability (c, s) within the model in Figure 3, which shows three possible sample paths of the state variables (c, s).

1. (c_1, s_1): The firm starts at (c_1, s_1). The board receives negative news about the successor and positive news about the CEO, which results in a move to (c_1', s_1'). At this point, it is optimal for the board to replace the successor since the likelihood of the successor

becoming a suitable CEO is too low. As a consequence, (c, s) jumps to (c'_1, e).

2. (c_2, s_2): The firm starts at (c_2, s_2). The CEO is of high expected ability, as is the successor, but then the CEO leaves for exogenous reasons τ_λ and the firm moves to $(0, s_2)$. The board decides to act by promoting the successor and hiring a new successor, which moves the firm to (s_2, e).

3. (c_3, s_3): The firm starts at (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 firm to (e, s'_3).

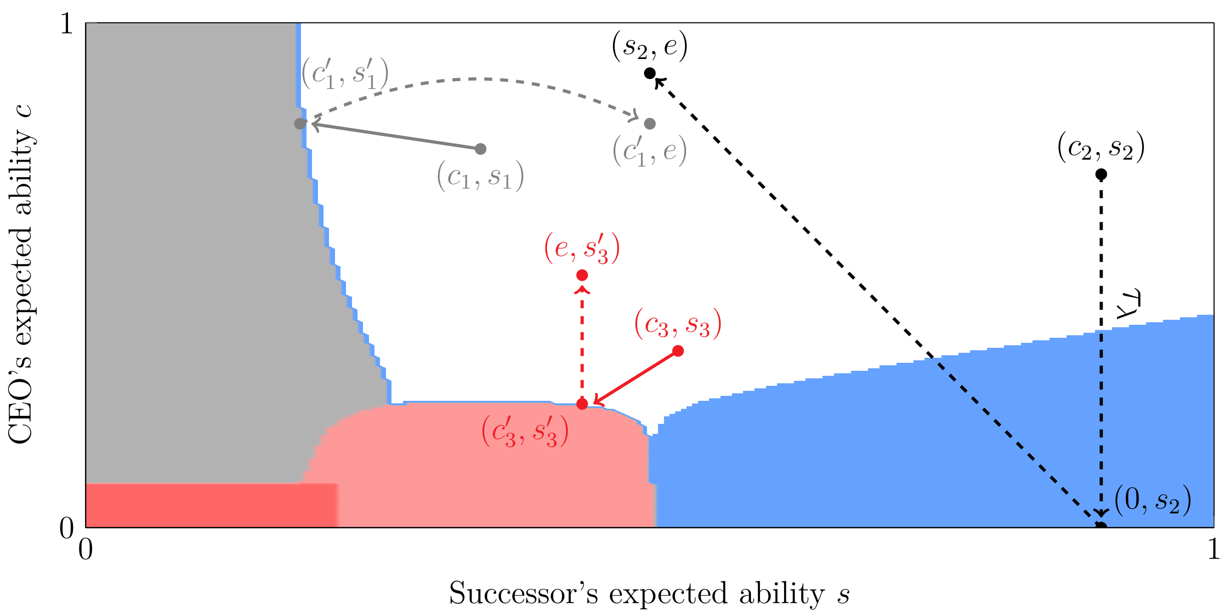

Figure 3: **Different Sample Paths**. The figure shows the solution of the model and state variables (c, s) dynamics given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

II Model Analysis

In this section, we analyse the model's predictions about the firm's succession planning. We also analyze who the board chooses as the new CEO. Additionally, in Appendix A we study how executives affect the firm's equity value and in which case they depart from the firm.

A Succession Planning

In our model, firms can also 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). In both cases, the board's succession strategy maximizes the equity value. Therefore, the absence of a successor and the apparent absence of succession planning—no direct replacement of a departing CEO—may not necessarily indicate that the firm is badly run, as suggested by prior empirical work (Fernández-Aráoz et al., 2021).

The firm might not appoint a new CEO for two reasons. First, because it is expensive for firms to appoint CEOs. Second, because appointing a subpar CEO today is costly as it increases the effective cost of hiring a new CEO in the future. The reason is that the firm has to forgo future cash flows generated by this subpar CEO when letting her go decreasing the benefits of appointing a new CEO,

$$\underbrace{\max\{V(s,0), V(e,s) - \Phi\} - K - V(c,s)}_{\textit{Benefits of new CEO given current CEO}} \leq \underbrace{\max\{V(s,0), V(e,s) - \Phi\} - K - V(0,s)}_{\textit{Benefits of new CEO given no current CEO}}.$$

The same reasoning causes the board's CEO departure strategy to be a threshold one, see Proposition 7 in Appendix A.

The following proposition shows that the cost of appointing a new CEO K plays an important role in this mechanism. When this cost is too high, the board strategically delays appointing a new CEO. Furthermore, the more able the successor, the higher the cost 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 to not directly appoint a new CEO*

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

Figure 4 shows the board's optimal actions when the replacement cost K is high. When the CEO leaves for an exogenous reason and the successor is not too able, then the board will not appoint a new CEO until the successor's expected ability reaches the blue region. The board thus optimally delays succession.

These results shed light on the apparent absence of succession planning found in many corporations (Cvijanović et al., 2022; Larcker et al., 2022) and on the long delays in appointing a new CEO, which can also be optimal for firms as Rivolta (2018) and Gabarro et al. (2022) find. If in practice smaller firms face relatively higher 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. This result is consistent with: *i*) 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, *ii*) Cvijanović et al. (2022) who find that larger firms are more likely to have a succession plans, and *iii*) Gabarro et al. (2022) who show that smaller firms are more likely to have protracted successions.

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

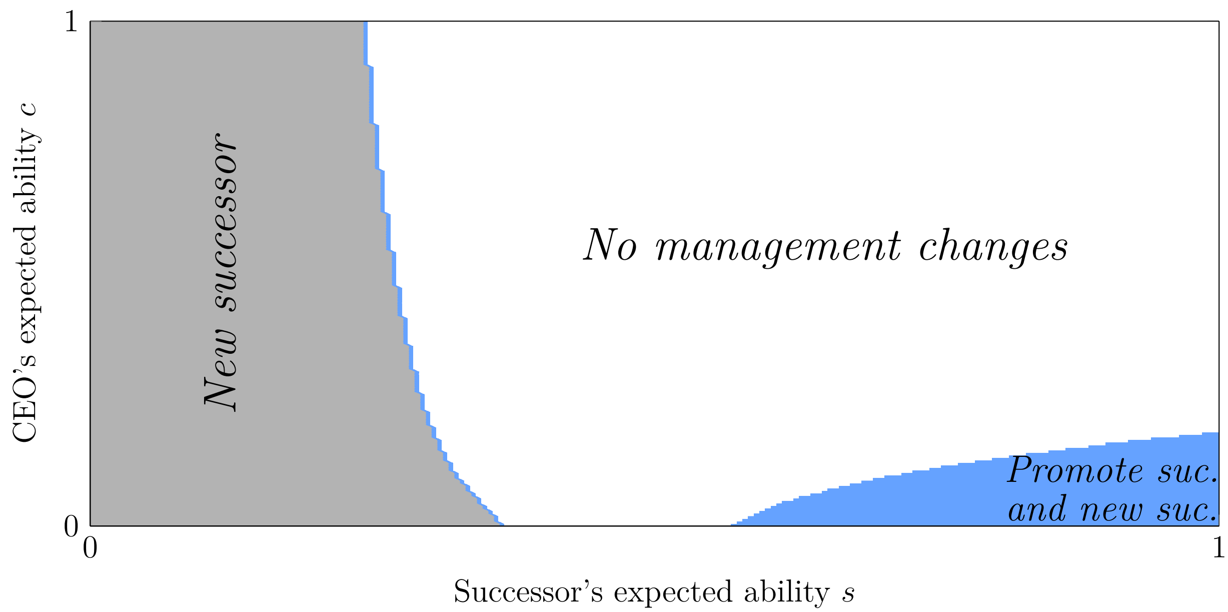

Figure 4: **Delayed Succession**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 2.5, 0.5, 0.35)$. Appendix C describes the numerical algorithm used to solve the model.

appoints an external candidate to directly replace the firm's CEO, $c = e$.[11] If the board promotes an internal successor then we call this an *internal succession*, $c = s$. We show that the prevalence of internal and external successions crucially depends on learning about the successor's ability. As we demonstrate in the following proposition, without learning about the successor's ability by the board ($\phi^s = 0$), 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 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 cost of searching for an external candidate,* $\Phi > 0$*, and there is no current*

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

successor, $s = 0$. Then in the future there are only external successions.

Figure 5 highlights the succession dynamics in this case. Because there is no successor, the firm remains at $s = 0$. The CEO leaves for exogenous reasons at τ_λ or when the CEO's expected ability drops to $\underline{c}(0)$ in either case the firm hires an external candidate to become the new CEO. From the figure it also becomes clear that the firm never hires a successor. The figure gives 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 at $(e, 0)$ again. There are only external successions in this case. This result highlights that learning about the successor gives the firm an incentive to engage in internal successions.

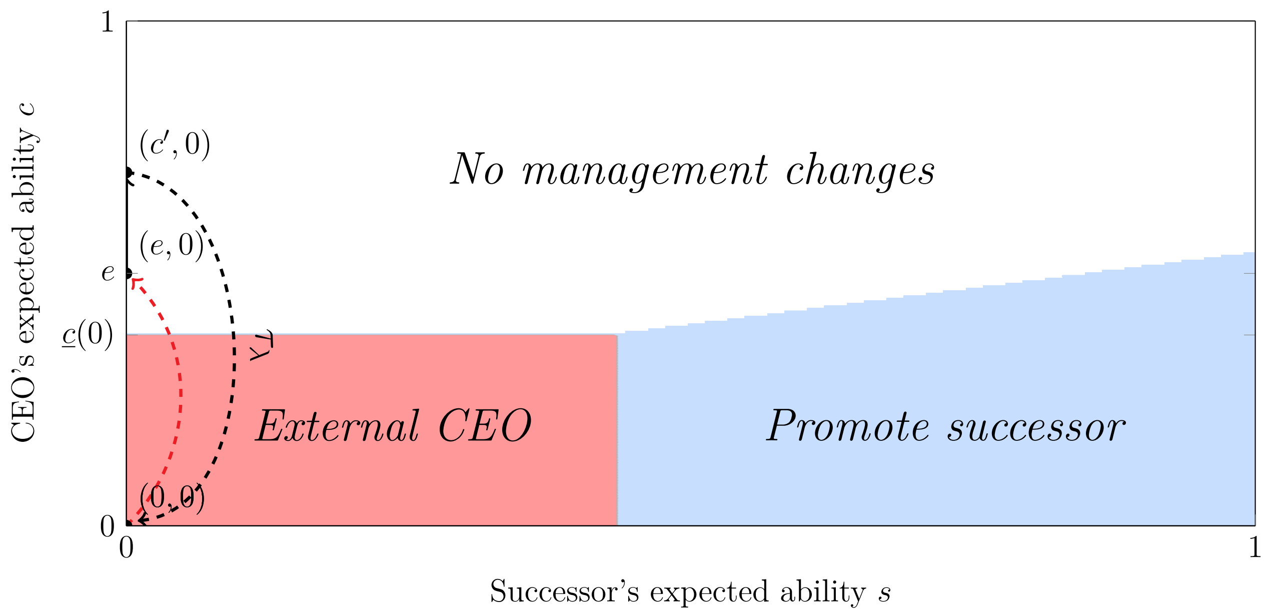

Figure 5: **No Learning Leads to External Successions**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0, 0, 0.4, 0.5, 0.5)$. Appendix C describes the numerical algorithm used to solve the model.

On the other hand, when there are no search costs, $\Phi = 0$, and when the board learns about the successor, $\phi^s > 0$, then the firm's successor is almost surely better than the external candidates. The reason is that when the firm does not have to incur search costs, an inferior successor $S_t < e$ would be directly replaced at no cost by an external candidate. Consequently, the successor's expected ability S_t is higher than the external candidates' expected ability e, giving the board an incentive to promote the successor.

Proposition 3 (No Search Cost)**.** *Assume that there is learning, $\phi^s > 0$, there are no costs of searching for an external candidate, $\Phi = 0$, the CEO contributes more to the equity value than the successor, $c_1 \geq c_2 \Rightarrow V(c_1, c_2) \geq V(c_2, c_1)$, and the firm employs a successor of ability $s \geq e$. Then in the future there will only internal successions.*[12]

Figure 6 highlights 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 $S_t < e$. Therefore, the only way for the firm to replace the CEO is via the blue region, in which the board promotes the successor to CEO and hires a new successor. Therefore, there are only internal successions.

Some of the main results of our paper follow from Propositions 2 and 3. First, our model can rationalize the fact that firms appear to prefer hiring internal successors, as documented by Parrino (1997), Huson et al. (2004) or Cziraki and Jenter (2022). These internal successions are driven by the board learning about the successor. Employing the successor is akin to a real option. Second, Propositions 2 and 3 demonstrate (in limiting cases) that firms allow for more internal successions when they have to incur lower search costs ($\Phi \downarrow$) or when they learn more about the successor ($\phi^s \uparrow$).[13]

[12] 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.

[13] Assuming that the learning in our model is about firm-specific human capital and that this human capital is less important for PE-backed firms who rely more on general managerial ability ($\phi^s \downarrow$) then our model can explain the lower incidence of internal succession in PE-backed firms that Gompers et al. (2023) find.

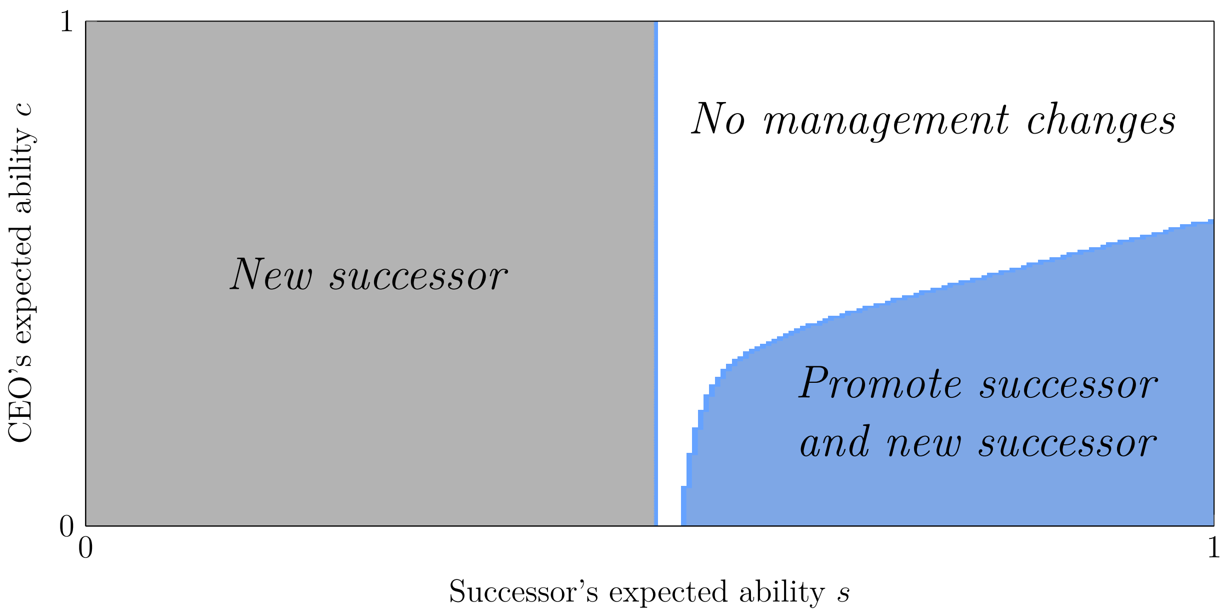

Figure 6: **No Search Cost Leads to Internal Successions**. The figure shows the solution of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0)$. Appendix C describes the numerical algorithm used to solve the model.

Additionally, our results imply that higher levels of internal successions do not necessarily mean that the market for CEOs is inefficient. In our model, lower search costs ($\Phi \downarrow$) have two effects. First, they make hiring external candidates less expensive, so that external succession is more likely. Second, lower search costs are associated with a less costly replacement of the successor, which results in the firm employing successors of higher expected ability and therefore increases the incidence of internal successions. Proposition 3 shows that this second effect dominates as the labor market becomes frictionless. Therefore, 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).

C Robustness

We discuss below how the results in Proposition 2 and 3 are affected by a labor market equilibrium, when the external candidates' expected ability is unknown or there is learning about the external candidates' ability, and when both the CEO and successor affect the firm's cash flows.

Labor Market Equilibrium

Propositions 2 and 3 hold true even in a labor market equilibrium in which the ability of the external candidates is endogenous $e^*(r, \lambda, \phi^c, \phi^s, K, \Phi) \in [0, 1]$. The reason is that both propositions do not depend on a specific value for 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 $e^*(r, \lambda, \phi^c, \phi^s > 0, K, \Phi = 0)$ in Proposition 3.

Unknown Ability of External Candidates

Propositions 2 and 3 are also robust to external candidates having different ex ante unknown expected abilities. Instead of a constant expected ability e, we assume that the expected ability of an external candidate is independently and identically distributed according to a probability density function $f(\cdot) > 0$ on the domain $[\underline{e}, \bar{e}]$ where $\bar{e} < 1$. In the absence of learning, the firm still has no incentive to hire a successor leading to only external successions. In the absence of labor market frictions $\phi = 0$, the firm would repeatedly search for new external candidates until it finds one of type $\bar{e}$ and then hire this one. 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 can extend our model such that there is learning about the external candidates. For example, we can have that the expected ability of external candidates becomes time-varying e_t and follows a learning process similar to the CEO 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 a 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. Internal successions can thus also arise when the board learns about external candidates. 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.[14]

Cash Flows Affected by Successor

We now analyze what happens if the successor also 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 individually 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

[14] What is important is that hiring on the labor market does not affect e_t. If it would then the firm might have an incentive to delay hiring a successor to maintain access to 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 poached by another firm then our firm might have the incentive to employ two successors.

small relative to the labor market search cost K 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.

III The CEO's Role in the Succession Process

Incumbent CEOs play an important role in the succession process (Bower, 2012; Berns and Klarner, 2017). However, CEOs may not always have the shareholders' best interest in mind, and may want to preserve their influence of the firm by sabotaging the successors (Boeker, 1992; Cannella and Shen, 2001; Zhang, 2006). For example, it has been reported that Disney's CEO Bob Iger undermined his hand-picked successor Bob Chapek.[15] In this section, we extend the baseline model by allowing the CEO to become endogenously entrenched by engaging in a *sabotage* of the successor (Salop and Scheffman, 1983; Lazear, 1989). By doing so, the CEO makes the successor worse off, so that she is less likely to be replaced by the successor. We show that compensation plays a crucial role in determining the CEO's incentives to sabotage and become entrenched and that the CEO's attempts to become entrenched can sometimes backfire and result in the CEO getting fired.

In the extended model, the CEO can sabotage the successor by negatively impacting the successor's ability. In practice, the CEO could, for example, not collaborate with the successor or not engage in mentoring, which would effectively make the successor less prepared and thus less capable in running the firm in the future. The CEO cannot sabotage external candidates because she has little direct interactions with them. We assume that the CEO has the same information as the board and thus does not know her own ability. At each time t, the CEO selects a level of sabotage $f_t \in [0, \bar{f}]$ to maximize her payoff, where $f_t = 0$ means that the CEO does not sabotage the successor. A level of sabotage f_t implies that a high-ability successor becomes a low-ability successor with intensity $f_t dt$. Therefore, this

[15]See "Bob's Your Uncle at Disney", Wall Street Journal, 26 December 2022.

level of sabotage lowers the expected ability of the successor by $-f_t S_t dt$. The dynamics of the successor's expected ability given the choice of sabotage f_t are

$$dS_t = -f_t S_t dt + \phi^s S_t(1 - S_t)dB_t^s.$$

The CEO's incentives to sabotage the successor depend on the CEO's compensation, which consists of two parts: a profit-based part and an equity stake, similar to Nikolov and Whited (2014). We assume that the CEO, just as shareholders, is risk-neutral and discounts cash flows at the rate $r > 0$. The CEO receives a fraction $\alpha \geq 0$ of the firm's profits when being in office, which amounts to $\alpha W(c, s)$. The results presented later would also hold if instead of a profit share part the CEO received a fixed wage or a utility flow from being the CEO. Notably, both forms of compensation increase with the CEO's tenure. The CEO is also granted a fraction $\beta \geq 0$ of the firm's equity $\beta V(c, s)$. We assume that the CEO's equity vests when leaving the firm (Edmans et al., 2017a). This implies that the CEO's total expected discounted compensation is

$$\alpha W(c, s) + \beta V(c, s). \tag{4}$$

At any time, the CEO's expected future compensation is also given by Equation (4). We normalized the CEO's outside option to zero. In practice, CEO's personal income drops by around 40% after a forced turnover (Nielsen, 2016).

The value of the firm's cash flows until the CEO leaves is given by

$$W(c, s) = \mathbb{E}_{c,s}\left[\int_0^\tau e^{-rt} dX_t + \mathbb{I}_{\{\tau=\tau_E\}} e^{-r\tau} \mathbb{I}_{\{V(C_\tau,e)>\max(V(e,S_\tau)-K,V(S_\tau,e)-K)\}} W(C_\tau, e)\right].$$

The first term represents the profits that the firm generates from now until the moment when either the CEO or the successor gets replaced. The second term reflects the profits generated by the current CEO in case when only the successor gets replaced.

This problem corresponds to a dynamic game between the board and the current (and future) CEOs. The reason is that the CEO's optimal sabotage of the successor depends on the firm's succession policy, and vice versa. We study Markov Perfect Equilibria in (c, s) in this game (Maskin and Tirole, 2001). This means that *i*) the optimal sabotage and succession policies are a function of (c, s), *ii*) the CEO's sabotage policy is optimal given the firm's succession policy, and *iii*) the firm's succession policy is optimal given the CEO's sabotage policy.

Two remarks are in place here. First, given that we are studying Markov Perfect Equilibria, the CEO's level of sabotage f_t does not have to be observable by the board. In any equilibrium, the board correctly infers the level of sabotage. Second, there is no commitment on the side of the CEO or the board's side with regards to the future actions (as in DeMarzo and He, 2021).

In equilibrium, the CEO picks the level of sabotage $\{f_t\}_{t\geq 0}$ to maximize her expected discounted payoff. The impact of the CEO's sabotage f_t on her compensation is

$$-\left(\alpha W_s(c,s) + \beta V_s(c,s)\right) f_t S_t dt. \tag{5}$$

Therefore, the optimal level of sabotage is

$$f_t = \begin{cases} \bar{f} & \frac{\alpha}{\beta} < -\frac{V_s(c,s)}{W_s(c,s)} \\ 0 & \frac{\alpha}{\beta} \geq -\frac{V_s(c,s)}{W_s(c,s)} \end{cases}. \tag{6}$$

From Equation (6) it becomes clear that the CEO's compensation, as summarized by the fraction of the profit sharing part over the equity stake $\frac{\alpha}{\beta}$, is an important determinant of the level of sabotage.

As the following proposition shows, when given only the equity-based compensation, the CEO tries to maximize the firm's equity value and therefore does not sabotage the successor since it negatively impacts the equity value. As a consequence, the CEO endogenously does not become entrenched.

Proposition 4 (Equity Compensation and No Sabotage)**.** *When the CEO only receives equity compensation, $\alpha = 0$ and $\beta > 0$. In any equilibrium, the CEO does not sabotage the successor $f_t = 0$ and therefore does not become entrenched.*[16]

On the other hand, when the CEO receives only the profit-based compensation, then she is incentivized to prolong her tenure and, as a consequence, the CEO sabotages any sufficiently-abled successor to prevent getting replaced.

Proposition 5 (Profit-Based Compensation and Sabotage)**.** *Assume the CEO only receives profit-based compensation, $\alpha > 0$ and $\beta = 0$, and $\phi^c W_{cc}(c, s) \geq 0$. Given an equilibrium and a CEO and successor (c, s). This CEO sabotages this successor if and only if $S_t \geq \hat{s}(C_t|c, s)$.*[17]

The results in Propositions 4 and 5 show that CEO compensation plays a crucial role in determining sabotage and entrenchment in equilibrium. CEOs whose compensation is more equity-based should have less incentives to sabotage their successors and are therefore less entrenched. The same holds true for CEOs facing weaker successors.

How should the board optimally respond to a CEO who sabotages the successor? In Figure 7, we take the baseline parameter values from Figure 2 and assume that the firm is run by a CEO (and future CEOs) who always sabotages the successor(s). Figure 7 shows that the board responds in two distinct ways to the CEO's actions.[18] First, the board alters the hiring policy by delaying replacing a successor (as compared to Figure 2). The reason is that the CEO will also sabotage future successors, which results in the board being

[16] If the CEO is indifferent between sabotaging or not sabotaging the successor then she decides not to sabotage the successor.

[17] If the CEO is indifferent, then we assume the CEO sabotages the successor.

[18] This figure also shows that it is not always optimal for the CEO to sabotage the successor. In the region just to the right of the red-colored area, sabotage hurts the CEO's compensation because it lowers both the firm's equity value and the CEO's expected tenure.

less likely to hire one today. This change in the board's hiring policy negatively impacts the successor's expected ability above and beyond the direct effect of the CEO's sabotage, thereby further increasing managerial entrenchment. Second, the board alters the promotion policy and replaces the CEO sooner. Knowing that the CEO sabotages the successor lowers the option value of delaying succession. In response, the board changes the promotion policy and replaces the CEO with the successor earlier. Trying to become entrenched can thus backfire for the CEO, since the board anticipates her actions and acts accordingly.

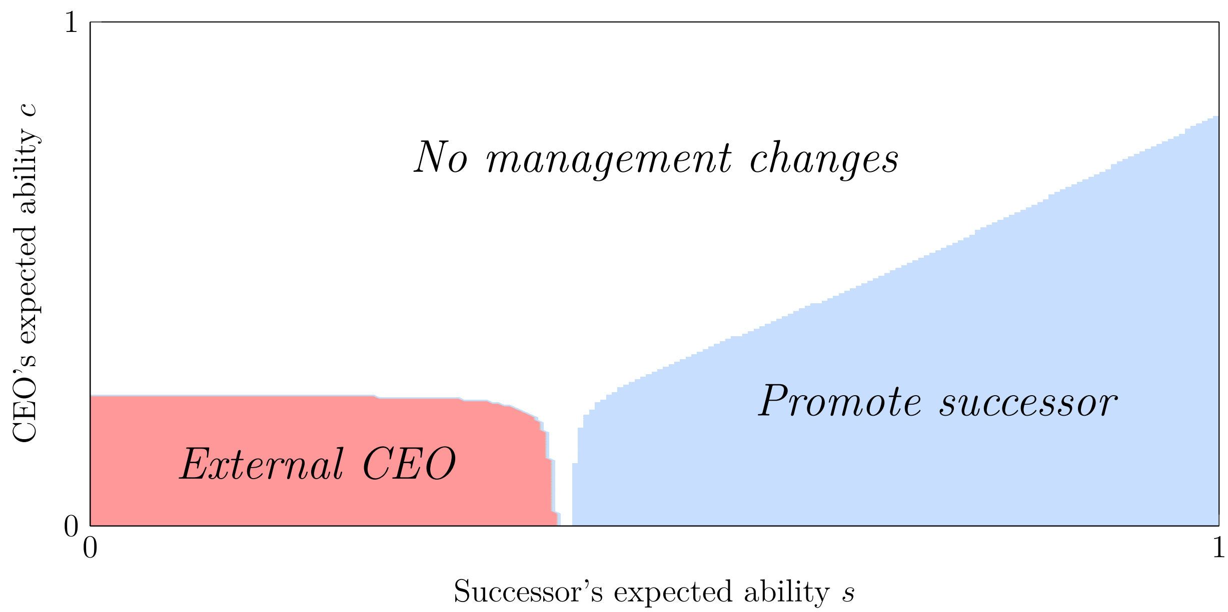

Figure 7: **The Firm's Response to Sabotage**. The figure shows the solution of the model in which the CEO always sabotages the successor given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi, \bar{f}) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5, 15\%)$. Appendix C describes the numerical algorithm used to solve the model.

A Mentoring

In practice, the CEO can also help foster executive talent within the firm. This mentoring by the CEO is an important part of the succession process and helps the successor develop herself into a future CEO (Moats and DeNicola, 2021). We can extend our model by allowing the CEO to mentor the successor. The CEO would select a level of mentoring $m_t \in [0, \bar{m}]$ to maximize her payoff and the dynamics of the successor's expected ability given the choice of mentoring m_t would be $dS_t = m_t(1 - S_t)dt + \phi^s S_t(1 - S_t)dB^s_t$.

In a setup with mentoring, we can derive several results. First, we can demonstrate that equity compensation would incentivize the CEO to mentor the successor as it increases the firm's equity value. Second, we can prove that profit-based compensation would make it more likely for the CEO to mentor the successor if and only if the successor is sufficiently weak. The reason is that mentoring a too able successor would increase the likelihood of the CEO being replaced while mentoring a less able successor would decrease the likelihood of this successor being replaced by a more able one. Third, the firm would respond to the CEO mentoring the successor by lowering the chances of replacing the successor, which would prolong the CEO's tenure.

IV Conclusion

We develop a dynamic model of CEO succession. In the model, the board learns about the ability of the CEO and successor and can replace the CEO by the successor or search for an external candidate. As a consequence, the presence of a successor within the firm is akin to a real option.

We use our model to rationalize the prevalence of internal CEO successions, the apparent absence of succession planning, and the delays in appointing new CEOs. Our results also demonstrate that more efficient labor markets are associated with a higher incidence of internal successions, which indicates that internal successions may not necessarily be a sign of labor market inefficiencies.

Finally, we study the CEO's role in the succession process and find that the CEO might have an incentive to sabotage her successor. This sabotage fosters managerial entrenchment but can also result in the CEO getting fired. Overall, our analysis highlights the importance of succession planning in shaping corporate decisions and outcomes.

References

Almazan, A. and Suarez, J. (2003). Entrenchment and severance pay in optimal governance structures. *The Journal of Finance*, 58(2):519–547.

Anderson, R. W., Bustamante, M. C., Guibaud, S., and Zervos, M. (2018). Agency, firm growth, and managerial turnover. *The Journal of Finance*, 73(1):419–464.

Bandiera, O., Prat, A., Hansen, S., and Sadun, R. (2020). CEO behavior and firm performance. *Journal of Political Economy*, 128(4):1325–1369.

Bennedsen, M., Pérez-González, F., and Wolfenzon, D. (2020). Do CEOs matter? Evidence from hospitalization events. *The Journal of Finance*, 75(4):1877–1911.

Berns, K. V. and Klarner, P. (2017). A review of the CEO succession literature and a future research program. *Academy of Management Perspectives*, 31(2):83–108.

Bertrand, M. and Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *The Quarterly Journal of Economics*, 118(4):1169–1208.

Boeker, W. (1992). Power and managerial dismissal: Scapegoating at the top. *Administrative Science Quarterly*, 37(3):400–421.

Bower, J. L. (2012). Managing your CEO's succession. In Lorsch, J. W., editor, *The future of boards: Meeting the governance challenges of the twenty-first century*, chapter 3, pages 53–75. Harvard Business Review Press.

Cannella, A. A. J. and Shen, W. (2001). So close and yet so far: Promotion versus exit for CEO heirs apparent. *Academy of Management Journal*, 44(2):252–270.

Casamatta, C. and Guembel, A. (2010). Managerial legacies, entrenchment, and strategic inertia. *The Journal of Finance*, 65(6):2403–2436.

Celentano, F. and Mello, A. (2023). Succession planning. *Working Paper, University of Lausanne*.

Chaigneau, P. and Sahuguet, N. (2018). The effect of monitoring on CEO compensation in a matching equilibrium. *Journal of Financial and Quantitative Analysis*, 53(3):1297–1339.

Chaigneau, P. and Sahuguet, N. (2023). The complementarity between signal informativeness and monitoring. *Journal of Accounting Research*, 61(1):141–185.

Chan, W. (1996). External recruitment versus internal promotion. *Journal of Labor Economics*, 14(4):555–570.

Chen, K.-P. (2003). Sabotage in promotion tournaments. *Journal of Law, Economics, and Organization*, 19(1):119–140.

Chen, K.-P. (2005). External recruitment as an incentive device. *Journal of Labor Economics*, 23(2):259–277.

Chowdhury, S. M. and Gürtler, O. (2015). Sabotage in contests: A survey. *Public Choice*, 164:135–155.

Cvijanović, D., Gantchev, N., and Li, R. (2022). CEO succession roulette. *Management Science*.

Cziraki, P. and Jenter, D. (2022). The market for CEOs. *Working Paper, London School of Economics*.

Daley, B., Geelen, T., and Green, B. (2023). Due diligence. *Forthcoming, The Journal of Finance*.

DeMarzo, P. M. and He, Z. (2021). Leverage dynamics without commitment. *The Journal of Finance*, 76(3):1195–1250.

DeVaro, J. and Morita, H. (2013). Internal promotion and external recruitment: A theoretical and empirical analysis. *Journal of Labor Economics*, 31(2):227–269.

Edmans, A., Fang, V. W., and Lewellen, K. A. (2017a). Equity vesting and investment. *The Review of Financial Studies*, 30(7):2229–2271.

Edmans, A., Gabaix, X., and Jenter, D. (2017b). Executive compensation: A survey of theory and evidence. *The Handbook of the Economics of Corporate Governance*, 1:383–539.

Eisfeldt, A. L. and Kuhnen, C. M. (2013). CEO turnover in a competitive assignment framework. *Journal of Financial Economics*, 109(2):351–372.

Fee, C. E. and Hadlock, C. J. (2004). Management turnover across the corporate hierarchy. *Journal of Accounting and Economics*, 37(1):3–38.

Fernández-Aráoz, C., Nagel, G., and Green, C. (2021). The high cost of poor succession planning. *Harvard Business Review*.

Fischer, E. O., Heinkel, R., and Zechner, J. (1989). Dynamic capital structure choice: Theory and tests. *The Journal of Finance*, 44(1):19–40.

Gabaix, X. and Landier, A. (2008). Why has CEO pay increased so much? *The Quarterly Journal of Economics*, 123(1):49–100.

Gabarro, M., Gryglewicz, S., and Xia, S. (2022). Lame-duck CEOs. *Working Paper, Erasmus University*.

Gompers, P. A., Kaplan, S. N., and Mukharlyamov, V. (2023). The market for CEOs: Evidence from private equity. *Working Paper, University of Chicago*.

Hansen, L. P., Khorrami, P., and Tourre, F. (2018). Comparative valuation dynamics in models with financing restrictions. *Working Paper, University of Chicago*.

Harris, M. and Holmstrom, B. (1982). A theory of wage dynamics. *The Review of Economic Studies*, 49(3):315–333.

He, L. and Schroth, E. (2024). Why are CEOs rarely succeeded by external candidates? *Working Paper, EDHEC Business School*.

Hermalin, B. E. (2005). Trends in corporate governance. *The Journal of Finance*, 60(5):2351–2384.

Hermalin, B. E. and Weisbach, M. S. (1998). Endogenously chosen boards of directors and their monitoring of the CEO. *American Economic Review*, 88(1):96–118.

Huang, R. (2016). Executive job matching: Estimates from a dynamic model. *Working Paper, University of Rochester*.

Hugonnier, J., Malamud, S., and Morellec, E. (2015). Credit market frictions and capital structure dynamics. *Journal of Economic Theory*, 157:1130–1158.

Huson, M. R., Malatesta, P. H., and Parrino, R. (2004). Managerial succession and firm performance. *Journal of Financial Economics*, 74(2):237–275.

Jenter, D. and Lewellen, K. (2021). Performance-induced CEO turnover. *The Review of Financial Studies*, 34(2):569–617.

Jenter, D., Matveyev, E., and Roth, L. (2021). Good and bad CEOs. *Working Paper, London School of Economics*.

Kaplan, G., Moll, B., and Violante, G. (2020). Two assets and kinked adjustment costs. *Note, London School of Economics*.

Khurana, R. (2000). Three-party exchanges: The case of executive search firms and CEO search. *Working Paper, Harvard Business School*.

Kuhnen, C. M. and Zwiebel, J. (2008). Executive pay, hidden compensation and managerial entrenchment. *Working Paper, Stanford University*.

Larcker, D. F. and Tayan, B. (2022). CEO succcession: Data spotlight. *Corporate Governance Research Initiative, Stanford Graduate School of Business*.

Larcker, D. F., Tayan, B., and Watts, E. M. (2022). Firing and hiring the CEO: What does CEO turnover data tell us about succession planning? *Working Paper, Stanford University*.

Lazear, E. P. (1989). Pay equality and industrial politics. *Journal of Political Economy*, 97(3):561–580.

Lazear, E. P. and Oyer, P. (2007). Personnel economics. *Working Paper, NBER*.

Maskin, E. and Tirole, J. (2001). Markov perfect equilibrium: I. Observable actions. *Journal of Economic Theory*, 100(2):191–219.

Mauer, D. C. and Ott, S. H. (1995). Investment under uncertainty: The case of replacement investment decisions. *Journal of Financial and Quantitative Analysis*, 30(4):581–605.

McConnell, J. J. and Qi, Q. (2022). Does CEO succession planning (disclosure) create shareholder value? *Journal of Financial and Quantitative Analysis*, 57(6):2355–2384.

Moats, M. C. and DeNicola, P. (2021). How the best boards approach CEO succession planning. *Harvard Law School Forum On Corporate Governance*.

Murphy, K. J. and Zabojnik, J. (2004). CEO pay and appointments: A market-based explanation for recent trends. *American Economic Review*, 94(2):192–196.

Nguyen, B. D. and Nielsen, K. M. (2014). What death can tell: Are executives paid for their contributions to firm value? *Management Science*, 60(12):2994–3010.

Nickerson, J. (2013). A structural estimation of the cost of suboptimal matching in the CEO labor market. *Working Paper, University of Washington*.

Nielsen, K. M. (2016). Personal costs of executive turnovers. *Working Paper, Copenhagen Business School*.

Nikolov, B. and Whited, T. M. (2014). Agency conflicts and cash: Estimates from a dynamic model. *The Journal of Finance*, 69(5):1883–1921.

Oyer, P. and Schaefer, S. (2011). Personnel economics: Hiring and incentives. In *Handbook of Labor Economics*, volume 4, pages 1769–1823. Elsevier.

Parrino, R. (1997). CEO turnover and outside succession a cross-sectional analysis. *Journal of Financial Economics*, 46(2):165–197.

Rivolta, M. L. (2018). Worth the wait? Delay in CEO succession after unplanned CEO departures. *Journal of Corporate Finance*, 49:225–251.

Salop, S. C. and Scheffman, D. T. (1983). Raising rivals' costs. *The American Economic Review*, 73(2):267–271.

Shleifer, A. and Vishny, R. W. (1989). Management entrenchment: The case of manager-specific investments. *Journal of Financial Economics*, 25(1):123–139.

Taylor, L. A. (2010). Why are CEOs rarely fired? Evidence from structural estimation. *The Journal of Finance*, 65(6):2051–2087.

Terviö, M. (2008). The difference that CEOs make: An assignment model approach. *American Economic Review*, 98(3):642–668.

Tsoulouhas, T., Knoeber, C. R., and Agrawal, A. (2007). Contests to become CEO: Incentives, selection and handicaps. *Economic Theory*, 30:195–221.

Waldman, M. (2003). Ex ante versus ex post optimal promotion rules: The case of internal promotion. *Economic Inquiry*, 41(1):27–41.

Waldman, M. (2013). Theory and evidence in internal labor markets. In *Handbook of Organization Economics*, pages 520–574. Princeton University Press.

Xu, J. and Yang, J. (2016). Golden hellos: Signing bonuses for new top executives. *Journal of Financial Economics*, 122(1):175–195.

Zhang, Y. (2006). The presence of a separate COO/president and its impact on strategic change and CEO dismissal. *Strategic Management Journal*, 27(3):283–300.

Zwiebel, J. (1996). Dynamic capital structure under managerial entrenchment. *American Economic Review*, 86(5):1197–1215.

Appendix

The first appendix (Appendix A) contains additional analysis regarding the impact of executives on the firm's equity value and their departure policies. The second appendix (Appendix B) contains the proofs. The third appendix (Appendix C) the numerical implementation of the baseline model.

A Model Analysis

I CEO Ability and Equity Value

We first study how the CEO's and the successor's expected abilities affect equity value. As the following proposition shows, the firm is always better off by having a CEO and a successor of a higher expected ability.

Proposition 6 (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 firm's 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., 2021). An additional prediction of our model is that equity value should also increase in the successor's expected ability.

II Departures

We next focus on analyzing when executives depart from the firm. We establish that the CEO's departure policy comes in a threshold form. If the board wants to replace the CEO due to insufficient ability, then the board will also replace any worse CEO.

Proposition 7 (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 comes in a threshold form. If the board wants to replace the successor due to insufficient ability, then the board will also replace any worse successor.

Proposition 8 (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 shows these departure thresholds given the parameters of Figure 2 and documents that these 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.

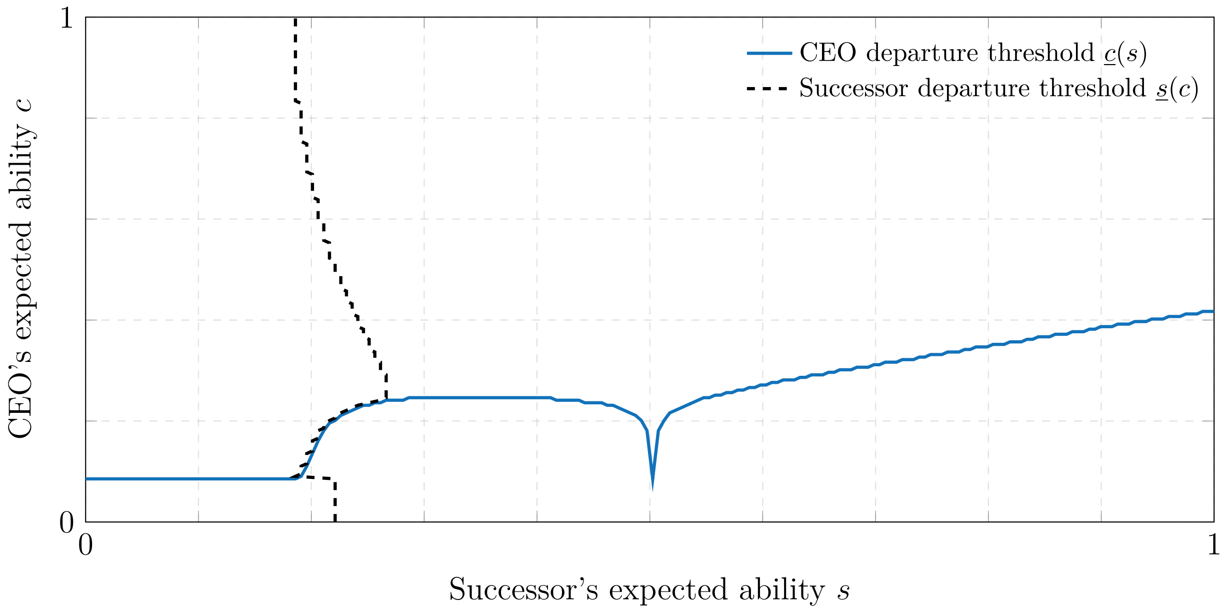

Figure A.1: **CEO and Successor Departure Thresholds**. The figure shows the CEO departure threshold $\underline{c}(s)$ and the successor departure threshold $\underline{s}(c)$ of the model given the parameters $(r, \lambda, \phi^c, \phi^s, K, e, \Phi) = (4\%, 10\%, 0.5, 0.5, 0.4, 0.5, 0.5)$. Appendix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

B Proofs

Given the result in Corollary 1, all proofs expect for the proof of Proposition 5 are done for the case $\mu = 0$ without loss of generality.

Proof of Proposition 6. Given the board's beliefs, we have that $dX_t = C_t dt + \frac{1}{\phi^c} dB^c_t$. Assume that $c' > c$. Given a sample path of $B^c_t(\omega)$, 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 follows from the fact that the firm's optimal policies maximize its equity value.

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

Proof of Proposition 7. 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 then 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 the equity value is weakly increasing in c (Proposition 6).[19] □

Proof of Proposition 8. 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 then 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 6). □

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.

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 7 implies that the CEO gets replaced as 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.

[19] Observe that the board would never strictly prefer to let the CEO go without replacing her as the expected cash flows she generates are non-negative $C_t dt \geq 0$.

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

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

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 $K > 0$ 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 follows from the expected cash flows the firm receives until $\min\{\tau_C,\tau_\lambda\}$. The inequality follows from 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 follows from 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 successions. □

Proof of Proposition 3. See footnote 12 for additional assumptions. From Proposition 6 it follows that $V_s(c,s) \geq 0$. 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 firm's successor has an expected ability $s \geq e$.

For $s > e$, if it is ever (strictly) optimal to hire an external successor then we must have that $V(s,e) < V(e,s)$ but since $s > e$ and $c_1 \geq c_2 \Rightarrow V(c_1,c_2) \geq V(c_2,c_1)$ this can't 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 timing we assume at each time t in footnote 12. Therefore, at $s = e$ only internal successions take place. □

Proof of Proposition 1. Let $\tilde{V}(0,s)$ be the equity value when the board acts as if its 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 follows 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 from the fact that the firm's optimal policies maximize its equity value

Assume $K > \tilde{K}(s) = \frac{\max\{e,s\}}{r+\lambda}$. From equation (A.1), Proposition 6, and the fact that $\Phi \geq 0$ it then 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 $\tilde{K}'(s) \geq 0$. From this it directly follows that the function $\bar{K}(s)$ exists. □

Proof of Proposition 4. Given a Markovian sabotaging strategy $f(c,s)$ and $c' = c$, for any sample path $(B_t^c(\omega), B_t^s(\omega))$ if $s' > s$ then for the current successors s' and s it holds that $S_t'(\omega) \geq S_t(\omega)$.[20] If the successors s' and s would get promoted at the same time then this result implies that when they are CEOs $C_t'(\omega) \geq C_t(\omega)$.

Let $\tilde{V}(c,s')$ be the equity value assuming the board acts as if the current successor is of expected ability s instead s'. In that case

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

The first inequality follows from the fact that the cash flows are at least as large for $\tilde{V}(c,s')$ as for $V(c,s)$ given that when the current successors s' and s become CEOs (at the same time) then $C_t'(\omega) \geq C_t(\omega)$. The second inequality follows from the fact that $V(c,s)$ maximizes the equity value. Therefore, $V_s(c,s) \geq 0$.

The CEO's compensation is $\beta V(c,s)$. The impact of the CEO's sabotaging at time t on her compensation is

$$
\max_{f_t \in [0,\bar{f}]} -f_t \beta V_s(c,S_t) S_t dt \leq 0,
$$

which is maximized when $f_t = 0$ as $\beta > 0$ and $V_s(c,s) \geq 0$. The CEO thus does not sabotage the successor and therefore does not become entrenched. □

Proof of Proposition 5. We know that

$$
W(c,s) \leq \mathbb{E}_{c,s}\left[\int_0^{\tau_\lambda} e^{-rt} dX_t\right] = \mathbb{E}_{c,s}\left[\int_0^{\tau_\lambda} e^{-rt}\left(\mu + C_t\right) dt\right] = \frac{\mu + c}{r+\lambda}
$$

as $\mathbb{E}_t\left[dX_t\right] \geq 0$, $dX_t = (\mu + C_t)\, dt + \frac{1}{\phi^c} dB_t^c$, and C_t is a martingale.

[20] The sample paths of $(C_{\tilde{t}}'(\omega), S_{\tilde{t}}'((\omega))$ and $(C_{\tilde{t}}((\omega), S_{\tilde{t}}((\omega))$ are continuous. Observe that $C_t'(\omega) = C_t(\omega)$ for any t. If for some t $S_t'(\omega) = S_t(\omega)$ then for any $\tilde{t} > t$ $(C_{\tilde{t}}'(\omega), S_{\tilde{t}}'((\omega)) = (C_{\tilde{t}}((\omega), S_{\tilde{t}}((\omega))$ as the sabotaging and shocks they face are the same. Therefore, $S_t'(\omega) \geq S_t(\omega)$.

Given that the sample paths of S_t and C_t are continuous as long as the current CEO and successor are in place, there exists a region $\mathcal{R} \subseteq [0,1]^2$ in which the firm stays until either the CEO or successor gets replaced. Therefore, we can restrict our attention to $\mathcal{R}$.

For $(c,s) \in \mathcal{R}$, we know that $W(c,s)$ solves the differential equation

$$(r+\lambda)W(c,s) = \mu+c+\max_{f\in[0,\bar{f}]}\{-fsW_s(c,s)\}+\frac{1}{2}(\phi^c)^2 c^2(1-c)^2 W_{cc}(c,s)+\frac{1}{2}(\phi^s)^2 s^2(1-s)^2 W_{ss}(c,s),$$

where the maximum operator follows from Equation (5) and the fact that $\alpha > 0$ and $\beta = 0$.

Since $W(c,s) \leq \frac{\mu+c}{r+\lambda}$ and $\phi^c W_{cc}(c,s) \geq 0$, we have that for $s \in (0,1)$

$$\begin{aligned}
\mu + c &\geq (r+\lambda)W(c,s) \\
&= \mu + c + \max_{f\in[0,\bar{f}]}\{-fsW_s(c,s)\} + \frac{1}{2}(\phi^c)^2 c^2(1-c)^2 W_{cc}(c,s) + \frac{1}{2}(\phi^s)^2 s^2(1-s)^2 W_{ss}(c,s) \\
&\geq \mu + c + \frac{1}{2}(\phi^s)^2 s^2(1-s)^2 W_{ss}(c,s), \\
0 &\geq W_{ss}(c,s).
\end{aligned}$$

As a consequence, $W(c,s)$ is concave in s for $(c,s) \in \mathcal{R}$ and therefore $W_s(c,s)$ can cross zero at most once from above and a threshold sabotaging strategy $\hat{s}(C_t|c,s)$ where this CEO sabotages this successor if and only if $S_t \geq \hat{s}(C_t|c,s)$ maximizes the CEO's compensation. □

C Numerical Procedure

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

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

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

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

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

where Δ_t is set sufficiently small to ensure convergence.

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

$$\begin{aligned}
&A^c V_{t+\Delta_t}(c, :) = B^c_t, \qquad \text{(A.2)}\\
&B^c_t = V_t(c, :) + \Delta_t \left(c + \lambda V_t(0, :) + \frac{1}{2} (\phi^c)^2 c^2(1 - c)^2 \frac{\partial^2 V_t(c, :)}{\partial^2 c} \right),\\
&A^c = I (1 + \Delta_t (r + \lambda)) - \Delta_t M,\\
&M_{i,i} = -\frac{(\phi^s)^2 s_i^2(1 - s_i)^2}{\Delta_s^2},\\
&M_{i,i\pm1} = \frac{(\phi^s)^2 s_i^2(1 - s_i)^2}{2\Delta_s^2},
\end{aligned}$$

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

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

where $\Delta_c = c_2 - c_1$ is the step size of the grid of c. At the boundaries of the state space, we don't need to calculate the second-order derivatives since $\frac{1}{2} (\phi^s)^2 s^2(1 - s)^2 = 0$ for $s \in \{0, 1\}$

and $\frac{1}{2}(\phi^c)^2 c^2(1-c)^2 = 0$ for $c \in \{0,1\}$.[21] Equation (A.2) 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

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

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,

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

is sufficiently small. The algorithm is summarized in the figure below.

[21]For the model with sabotage (Section III), we also need to calculate the first-order derivative $\frac{\partial V(c,s)}{\partial s}$. We do this by using backward differences. We don't need to calculate the derivative at the boundary $s = 0$ since $-f(c,s)sdt = 0$.

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

$A^c = [(1 + \Delta_t (r + \lambda)) I - \Delta_t M]$

$B_t^c = V_t(c, :) + \Delta_t \left(c + \lambda V_t(0, :) + \frac{1}{2} (\phi^c)^2 c^2 (1 - c)^2 \frac{\partial^2 V_t(c,:)}{\partial^2 c} \right)$

```
        // 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 $error$