The Bright Side of Nepotism? Family CEOs, Turnover, and Firm Performance[1]

Barton H. Hamilton
Olin Business School, Washington University in St. Louis

Andrés Hincapié
University of North Carolina at Chapel Hill

Noah Lyman
University of North Carolina at Chapel Hill

ABSTRACT: Hiring CEOs with familial relations to the firm is often thought to be a dubious strategy akin to trading performance for family preferences. However, if the firm has additional prior information about related candidates, the availability of an additional pool of executive talent can have positive effects on firm performance. To explore these countervailing forces we estimate a dynamic model of CEO turnover. Executives may be hired from within or they can be outsiders. Firms learn about their executives' contribution to performance over tenure, and they possess relatively more prior information about the quality of internal candidates. Among internal candidates, firms have a distinct preference for those with familial relations to the firm. Using the model we analyze the effects of nepotism on firm performance. We find that nepotism impacts the quality of hired executives, firm performance, and the composition of executive hires. Nepotism raises the opportunity cost of employing unrelated CEOs, leading firms to increase selectivity when assessing the quality of unrelated candidates. Despite family members being held to a weaker performance standard caused by family preferences, firm performance is significantly lower on average when the option to hire related executives is eliminated. A milder policy that prevents family-to-family executive successions does increase firm net present value.

KEYWORDS: CEO Turnover, Family Firms, Firm Performance, Corporate Governance.
JEL CLASSIFICATION: G32, L25, M51.

[1] We thank Simone Hanna and Alejandro Gutiérrez-Li for expert research assistance and Luca Flabbi for his useful comments. We are also grateful to audiences of seminars at the University of North Carolina at Chapel Hill, Washington University in St. Louis, CREED conference at the College of Charleston, and DITE conference at Duke for valuable comments and feedback.

1 Introduction

CEOs are important determinants of firm performance (Bennedsen et al., 2020; Bertrand and Schoar, 2003). While several authors have found their contribution to be negatively affected by their familial relationship to the firm (Smith and Amoako-Adu, 1999; Bennedsen et al., 2007; Bertrand et al., 2008), family CEOs continue to be hired and they are three times less likely to be fired than outsider CEOs. A reason often suggested for this seeming contradiction is that family CEO appointments may be due less to merit and more to preferences such as the pleasure of passing the business onto the next generation. But there might be a bright side to family preferences as they can translate into boards of directors being more selective when hiring and firing other types of CEOs. Moreover, boards likely possess more information about the quality of family executive candidates, allowing them to better select at the hiring margin. Given that CEO replacement decisions have major consequences for firm performance (Weisbach, 1988; Parrino, 1997; Murphy, 1999; Peters and Wagner, 2014; Jenter and Kanaan, 2015) it is important that we address the ambiguity empirically. After all, depending on which forces dominate, blanket management strategies that ban family hires completely can do more harm than good to firm profitability.

In this paper we ask, what is the impact of nepotism on firm performance and personnel decisions? To answer this question we estimate a dynamic model of CEO turnover. Our framework extends the model of CEO replacement in Taylor (2010) in which the board of directors decides whether to fire or retain their CEO based on beliefs about the executive's contribution to firm performance. First, we allow the board to choose whether to appoint successors internally or externally and, as in Hermalin (2005), the board faces less uncertainty over the quality of internal hires. This is consistent with Quigley et al. (2019) who find that the variance of firm performance is significantly higher for outsider CEOs. In addition, we allow the board to select from three pools of candidates: an external pool (*outsider* CEOs), and two internal pools, pre-existing company employees (*insider* CEOs) and individuals with familial ties to the firm (*related* CEOs).[2] Second, the non-pecuniary cost component from firing a CEO (there are also pecuniary costs in the model) capture the potential nepotism motive in two ways: we allow these costs to vary by the type of the CEO being fired, capturing potentially higher entrenchment of related executives, and we also allow the board to draw non-pecuniary benefits from dynastic (related-to-related) successions.

Throughout the paper, we distinguish between family *management* and family *ownership*; the latter has been shown to be consequential for firm outcomes (Anderson and Reeb, 2003, 2004; Villalonga and Amit, 2006; Morck et al., 1988). A firm is family-managed if it has a related CEO, in other words, an executive with familial ties to the firm. A firm is family-owned, or more

[2] We use the terms family CEO and related CEO interchangeably in the rest of the paper.

precisely family-controlled, if the founding family owns at least 25 percent of outstanding shares.[3] As discussed in Villalonga and Amit (2008), family-owned firms frequently use control-enhancing mechanisms including dual-class share structures, disproportionate family representation on the board, and voting agreements to strengthen family control. Along with the substantial involvement of family members in firm operations, these mechanisms increase the likelihood of family hires. Conditional on turnover, family-controlled firms in our sample are eleven percentage points more likely to hire a related CEO than non-family-controlled firms. Note that even if a firm is not family-owned, they can still appoint a related CEO. For example, Anheuser-Busch is not family-owned but it employed a related CEO for six of the eleven years it is present in our sample. Conversely, a family-owned firm need not employ a related CEO. Walmart, while family-owned, does not employ a related CEO at any point during our sample period.

We estimate the model using simulated method of moments and panel data from publicly traded North American firms spanning from 1996 to 2014. Firm-level data are obtained from Compustat and executive-level data from Execucomp. We use Security and Exchange Commission DEF14 filings to identify CEOs with blood or marital ties to high-level firm personnel and complement these data with Internet searches. Family ownership is determined using the Osiris Ownership database. Since our focus is on firing and hiring decisions made by the firm, we separate cases of CEO turnover as forced or voluntary using data provided by Peters and Wagner (2014) and Jenter and Kanaan (2015). Consistent with previous literature, the forced turnover rate in our sample is fairly low, as only 2.8 percent of outsider CEOs and 2.1 percent of insider CEOs are fired in a given year.[4] Forced turnover is even less common for related CEOs, with only 0.9 percent fired each year. This gap in firing probabilities, which persists even after controlling for CEO performance, could be due to the existence of additional costs associated with firing family members. Alternatively, if there is greater uncertainty about the match quality of external hires, firms face a higher risk of unwittingly hiring a low-quality executive when hiring outsiders (Hermalin, 2005). In such cases, boards can exercise their option to fire and replace the CEO, which reduces the risk associated with hiring externally.

Our main finding highlights the value of family members as a source of CEO talent. Using our data and model estimates, we conduct a counterfactual experiment showing that an anti-nepotism policy prohibiting the hiring of related CEOs reduces the average firm's net present value by 4.8 percent and 2.1 percent for family-controlled and non-family-controlled firms, respectively.[5] This

[3]This threshold varies across the family firm literature. Claessens et al. (2000) classify a firm as family-owned if the founding family owns $\geq$ 5% of shares, Barth et al. (2005) use 33%, and Ang et al. (2000) use 50%. We use the same ownership data as Lins et al. (2013) and Ellul et al. (2017), and hence follow their threshold choice of 25%.

[4]See for example: Huson et al. (2001), Taylor (2010), Kaplan and Minton (2012).

[5]We calculate the change in net present value of profits over an 18 year period following the hiring of a CEO to incorporate the impact on both returns and turnover costs.

reflects two primary mechanisms. First, prior information on CEO quality is valuable. We estimate that the board of directors faces 40 percent less uncertainty when hiring a related (or insider) CEO so that these hires tend to be of higher quality.[6] For example, a one standard deviation improvement in CEO match quality increases profits by approximately $10 million per year for the median firm. Second, the prohibition on related candidates reduces the opportunity cost of hiring insider CEOs. The anti-nepotism mandate thus induces the board to be less selective when hiring, so that average CEO quality declines. These two mechanisms therefore imply that banning the hiring of a related CEO reduces profitability, particularly for family-controlled firms that have greater supply of family executive candidates.

Like much of the literature, we also find that hiring related CEOs can have a downside. Our estimates show that the non-pecuniary costs of firing a related CEO and the non-pecuniary benefits from generational successions are relatively high. While the estimated baseline cost from firing a CEO is 12.3 percent of total assets ($258.3 million for the median-sized firm), firms face a cost that is 33 percent higher from firing a related CEO ($355.1 million for the median-sized firm). We find supportive evidence that boards have preferences for dynastic transitions. The non-pecuniary benefits from related-to-related CEO transitions are about five percent of total assets ($104.2 million for the median-sized). This preference for generational successions explains the observed and documented decrease in the average quality of future generations of related CEOs who are appointed following another family member. For example, Bloom et al. (2010) find that firms led by "generation $N+1$" CEOs tend to be poorly managed, and the poor performance found by Peréz-González (2006) refers to CEOs who inherit control from another family member.

Given the potential costs of hiring a "dynastic" CEO, we then consider a counterfactual experiment that specifically prohibits related-to-related successions. This measure against dynastic handovers leads to an increase in the average net present value of 2.3 percent for family-controlled firms and 1.7 percent for non-family-controlled firms. This result reflects the fact that related successors are of systematically lower ability due to the dynastic preferences of the board. Because family-controlled firms have a higher likelihood of finding related executive talent, the impact of these anti-nepotism measures are more pronounced for these firms.[7] Overall, our counterfactual findings suggest that while blanket anti-nepotism policies may be costly for firms, soft bans targeting dynastic successions are value-enhancing.

Our paper contributes to the growing literature using dynamic structural models of CEO hiring and retention to analyze the impact of alternative personnel policies on firm outcomes. The papers most similar to ours are Taylor (2010) and Lippi and Schivardi (2014). Taylor (2010) estimates

[6] This is consistent with Quigley et al. (2019) who consider outsiders to be a riskier lottery than internal hires.

[7] We estimate that family-controlled firms are approximately three times as likely to have related candidates available when hiring a new CEO compared to non-family-controlled firms.

a dynamic model of CEO turnover in which firms face uncertainty about CEO quality which is gradually revealed by firm performance. Firms can replace their CEO at a cost upon learning that they are of sufficiently low quality, where the cost of replacement is estimated to be over $200 million for a median-sized firm. Crucially, most of this cost can be attributed not to monetary costs but to CEO entrenchment. Firms have distaste for firing CEOs, inducing a wedge between the implemented firing rule and the value-maximizing firing rule. We adapt this framework and use it to explore the implications of related CEO entrenchment; if familial relations decrease firms' willingness to fire a related CEO, Taylor's results suggest this may have consequences for shareholder value. The latter authors estimate a model of executive selection allowing firms to have non-pecuniary preferences for hiring CEOs who have personal relationships with firm personnel. Using data on Italian firms, they find that these preferences have a detrimental impact on firm performance. Their result points at the direct effect of nepotism: firms sacrifice performance in exchange for the non-pecuniary benefits gained from employing family. While our modeling approach is similar, we incorporate and expand the information structure presented in Hermalin (2005) and Taylor (2010). This allows us to capture indirect effects of nepotism reflected in hiring and termination decisions. Such indirect effects include the upward pressure that the pool of related candidates exercises on the hiring threshold for insider CEOs and on the firing threshold for both outsider and insider CEOs. Another paper using a similar approach is Ferraro (2021) who studies the impact of news coverage on female leadership.

The remainder of the paper proceeds as follows. Section 2 presents the data and discusses key empirical patterns that support our question and modeling choices. Section 3 outlines our dynamic model of CEO selection. Section 4 discusses identification and our estimation procedure. Section 5 presents the structural estimates and Section 6 presents counterfactual results. We discuss and conclude in Section 7.

2 Data

We use a panel of publicly traded North American firms spanning from 1996 to 2014. To construct the panel we merge firm information from databases Compustat, Osiris Ownership, and Execucomp.[8] Compustat provides information regarding firm fundamentals including balance sheet and income statement items. With this information we construct the return on assets (ROA).[9] Our final measure of firm performance corresponds to the industry-adjusted ROA (IA-ROA), which is the

[8] All three sources are accessible through the Wharton Research Data Services.

[9] ROA is commonly used in the literature as a measure of firm performance (Peréz-González, 2006; Bertrand et al., 2008; Taylor, 2010). It is calculated by dividing the earnings before interest and taxes (variable *oibdp* in Compustat) in year t by the midpoint of total assets in t and $t-1$.

ROA net of an industry-specific time trend.[10] Osiris Ownership provides information regarding the firm's ownership. Using the information in Osiris we classify firms in our sample as family-controlled (FC) firms or non-family-controlled (NFC) firms.[11] Following previous literature (Lins et al., 2013; Ellul et al., 2017), we define family-controlled firms as those in which a single individual or a group of relatives holds at least 25 percent of the shares. We merge this ownership classification with our main sample via text matching using both the firm's stock ticker and name. (See Appendix A.1.) Our classification yields 113 FC firms representing 4.3 percent of all firms in the sample. This share of FC firms is consistent with the one found in other Western countries (Lins et al., 2013). Execucomp provides information regarding the firm's CEO including tenure, demographic information, the length of prior employment at the firm (prior to becoming CEO), and turnover. These data sets are supplemented with data provided by Florian Peters (University of Amsterdam) who classifies cases of CEO turnover in Execucomp as forced or voluntary following the methodology outlined in Parrino (1997).

We classify CEOs according to their prior work-related or familial relation to the firm. For prior work-related relations we use Execucomp; for familial relations we rely mainly on Definitive Proxy Statements (DEF 14A) filed with the Security and Exchange Commission, which we supplemented with Internet searches.[12] *Outsider* CEOs are those with less than two years of experience at the firm when appointed, who have no familial relation to upper management (board members, previous CEOs, founders). *Insider* CEOs are those with more than two years of experience at the firm when appointed, who have no familial relation to upper management. *Related* CEOs are those with familial relations to upper management.[13] (See Appendix A.1 for more details about how the data set is constructed.)

Our final sample contains 26,762 observations with 2,644 unique firms and 4,521 distinct CEO spells corresponding to 4,428 unique CEOs.[14] Of the 4,521 CEO spells in the sample, 1,869 (41.3%) are outsiders, 2,237 (49.5%) are insiders, and 415 (9.2%) are related. The sample contains 2,167 instances of turnover, 590 (27.2%) of which are classified as forced while 1,577 (72.8%) are

[10]The IA-ROA is defined as:

$$IA\text{-}ROA_{it} \equiv ROA_{it} - \alpha_{it}^{ind} \tag{1}$$

where α_{it}^{ind} is an industry-specific time trend. We consider 9 industries as determined by the first digit of a firm's Standard Industry Classification (SIC) code. See details in Appendix A.1.

[11]See for example: Anderson and Reeb (2003), Anderson and Reeb (2004), Villalonga and Amit (2006), Morck et al. (1988).

[12]The DEF 14A includes details on items to be voted on at an upcoming shareholder meeting, board composition, and conflicts of interest among directors such as family ties between board members and other personnel at the firm.

[13]We do not split related CEOs into insiders and outsiders; in the data only 8.4% of related CEOs have less than two years of experience at the firm when appointed.

[14]The small difference between unique CEOs and distinct CEO spells is due to a very small minority of executives with CEO spells at more than one firm. Following Peréz-González (2006) we drop from the sample CEOs who only last one year (5.2% of hires) as their turnover is likely deterministic and due to interim arrangements.

classified as voluntary. The median CEO tenure is six years, with an average of 8.2 years and a standard deviation of 7.2 years.

2.1 Key Empirical Patterns

In this section we present empirical evidence that motivates our research question and model selection. The data show that performance has a large impact on CEO turnover and that firms with internal CEOs have higher mean and lower variance in performance. The data also reveal that the average of unexplained firm performance increases with tenure while the variance declines. Finally, we show that firms are less likely to fire related CEOs and that FC firms are more likely to appoint them.

Residual firm performance and familial relation to the firm have a large impact on forced turnover. The first stylized fact we explore is whether firms respond to underwhelming CEO performance by replacing their executives. In order to separate, in reduced form, CEO performance from persistence in productivity, we estimate an AR(1) process of industry-adjusted ROA and construct a proxy for the firm's information about the quality of the match using the cumulative residuals of the AR(1) process. Formally, we define the cumulative residuals of CEO j in firm i and time t as:

$$\hat{\theta}_{jit} \equiv \frac{1}{t - t_{ji} + 1} \sum_{\tau = t_{ji}}^{t} (y_{ji\tau} - \hat{\upsilon} y_{ji\tau-1}) \tag{2}$$

where y_{jit} is the IA-ROA, $\hat{\upsilon}$ is the estimate of productivity persistence from the AR(1) process, and t_{ji} is the beginning of CEO j's tenure at firm i. The variable $\hat{\theta}_{jit}$ captures the cumulative unexplained variation in profitability.[15] A high value of $\hat{\theta}_{jit}$ indicates a favorable performance during the executive's tenure, while a low value suggests the opposite.

Table 1 shows the marginal effect of $\hat{\theta}_{jit}$ on turnover using multinomial regression and controlling for CEO and firm characteristics. The cumulative performance residual has a negative and statistically significant effect on forced turnover. An increase of one standard deviation in $\hat{\theta}_{jit}$ decreases the probability of forced turnover by 0.4 percentage points (3.84×0.115) from a baseline probability of 3.1 percent, suggesting that firms are likely to integrate CEO performance in their turnover decisions. Insiders and related CEOs are significantly less likely to be forced out than outsiders, although the effect is larger for related executives. While insider CEOs are 0.8 percentage points less likely to be fired, related CEOs are 1.9 percentage points less likely to be fired, which is about two thirds of the baseline probability of forced turnover. Regarding voluntary turnover, the

[15] Cumulative residuals have been used previously in the literature to explore whether changes in information about occupational ability are associated with changes between entrepreneurship and paid employment (Hincapié, 2020).

TABLE 1: Marginals of Forced and Voluntary Turnover

	Forced *Baseline*: 3.1%		Voluntary *Baseline*: 6.7%	
	$\frac{\partial p}{\partial x}(\%)$	SE	$\frac{\partial p}{\partial x}(\%)$	SE
Cumulative performance residuals, $\hat{\theta}_{ijt}$	-.115***	(.030)	.029	(.054)
CEO characteristics				
Age	-.140***	(.029)	.783***	(.049)
Tenure	-.110***	(.032)	.087**	(.043)
Insider	-.829***	(.258)	.116	(.403)
Related	-1.94***	(.319)	-3.05***	(.477)
Firm type				
Family-controlled	-.288	(.670)	-.971	(.791)
Observations	17,979			

Notes: Marginal effects from a multinomial logit regression with the mutually exclusive alternatives being: retaining the CEO, forced turnover, and voluntary turnover. *Columns*: $\partial p/\partial x$ are the marginal changes in probability in percentage points; *SE* are the standard errors of the marginal effects; *, **, and *** denote significance at the 10% level, 5% level, and 1% level, respectively. *Rows*: *Cumulative performance residuals*, defined in equation (2), are a proxy for the current belief about the quality of the firm-CEO match; the base category for CEO type is *outsider*. The baseline point at which the derivatives are evaluated is the mean of the continuous variables and zeros for all binary variables. The value of the derivative for binary variables is the change in probability from a unit change. *Baseline* are the probabilities of forced and voluntary turnover evaluated at the baseline point.

cumulative performance residual has no statistically significant effect, revealing a weaker relation between performance and voluntary separation. CEO type does have a significant effect on voluntary turnover. Related CEOs are 3.1 percentage points less likely to voluntarily step down from a baseline probability of 6.7 percent. We also find that tenure and age decrease the likelihood of forced turnover and increase the likelihood of voluntary separation.

Firms with related and insider CEOs have higher mean and lower variance in performance. Panel A in Table 2 shows that on average firms with insider or related CEOs have higher return on assets than those with outsider CEOs. In addition, the variance of ROA is higher in firms with outsider CEOs. Table 2 also shows that the patterns in the raw data, which are consistent with Quigley et al. (2019), remain after adjusting the ROA by industry. Hermalin (2005) argues that these results may be explained by higher variance in the match quality of outsider executive candidates.

To explore these results further we approximate the quality of firm-CEO matches using the cumulative performance residual defined in (2). Our best approximation of the quality of the match is the cumulative performance residual at the last year of the CEO's tenure at the firm. Panel

TABLE 2: Summary Statistics by CEO Type

Panel A: Firm-Year Descriptives

	Outsiders		Insiders			Related		
	Mean	SD	Mean	SD	Δ	Mean	SD	Δ
ROA	12.1	(12.8)	13.9	(10.9)	1.86***	13.6	(11.7)	1.54***
IA-ROA	-1.18	(12.5)	.904	(10.1)	2.09***	.035	(11.1)	1.22***
Assets ($ billions)	14.0	(105.9)	25.1	(128.1)	11.11***	6.77	(22.1)	-7.21***
Observations (Firm-year)	10,066		13,052			3,644		

Panel B: Firm-CEO Descriptives

	Outsiders		Insiders			Related		
	Mean	SD	Mean	SD	Δ	Mean	SD	Δ
Cumulative performance residuals $\hat{\theta}_{ijt}$ at turnover	-.388	(4.64)	.038	(3.24)	.426***	.273	(3.22)	.661***
Observations (Firm-CEO)	1,684		2,019			386		

Notes: ROA is the firm's return on assets, defined as operating income divided by the midpoint of year t and $t-1$ assets. *IA-ROA* is the industry-adjusted ROA, i.e. the ROA net of an industry-specific time trend. Standard deviations (SD) are included in parentheses. Column Δ indicates the difference in means relative to outsiders; *, **, and *** denote significance at the 10% level, 5% level, and 1% level respectively. Assets are in real billion $U.S. indexed to 2012. *Cumulative performance residuals* are defined in equation (2); evaluated at turnover they are a proxy for the most precise belief about the quality of the firm-CEO match.

B in Table 2 shows that firms employing insider and related CEOs have on average higher residual performance than those employing outsiders. Put in dollar terms, firms with insider and related CEOs have an average residual return on assets of $38 and $273 per thousand dollars in assets, respectively. The average residual return on assets for firms with outsiders executives is -$388 per thousand dollars in assets. Besides, the unexplained performance residual under insider and related CEOs is more concentrated. The variance of performance residuals for outsiders is over twice that of related and insider CEOs.

The average of residual firm performance increases with tenure, its variance declines. Table 3 presents the results from a regression of the cumulative performance residual $\hat{\theta}_{jit}$ on CEO type, tenure, and year fixed effects. Column (1) shows that the cumulative performance residual increases significantly with respect to tenure. This positive selection is consistent with boards of directors who monitor CEO performance and force out executives of poor quality. Column (2) interacts tenure with CEO type, showing that the positive relation between tenure and the cumulative performance residual is attenuated for insider and related CEOs. Consistent with our results above, results here suggest that boards' decisions entail a starker positive selection for outsider CEOs.

TABLE 3: Cumulative Performance Residual and CEO Tenure

	(1)		(2)	
	Coefficient	SE	Coefficient	SE
Constant	-.090	(.636)	-.293	(.197)
Tenure	.010***	(.004)	.031***	(.006)
Insider	.389***	(.067)	.642***	(.112)
Related	.128	(.088)	.741***	(.165)
Insider × Tenure			-.029***	(.009)
Related × Tenure			-.049***	(.009)
Observations	17,979		17,979	

Notes: The dependent variable in both columns is the cumulative performance residual $\hat{\theta}_{jit}$. Column 1 estimates the slope of $\hat{\theta}_{jit}$ with respect to tenure, along with level differences in $\hat{\theta}_{jit}$ across CEO type. Column 2 includes interactions of tenure and CEO type. Outsider CEOs are the base group in both columns. *, **, and *** denote significance at the 10% level, 5% level, and 1% level respectively. We include year fixed effects in both regressions.

To explore further the existence of positive selection, Figure 1 plots the variance of the cumulative performance residual across firm-CEO matches for the first 10 years of tenure. The large variation in cumulative performance residuals at the beginning of a firm-CEO match rapidly decreases over the first ten years of tenure for all types of CEOs. Consistent with positive selection of CEOs over tenure, the results in Table 3 and Figure 1 suggest that the distribution of quality among retained CEOs shifts rightward and becomes more concentrated with tenure.

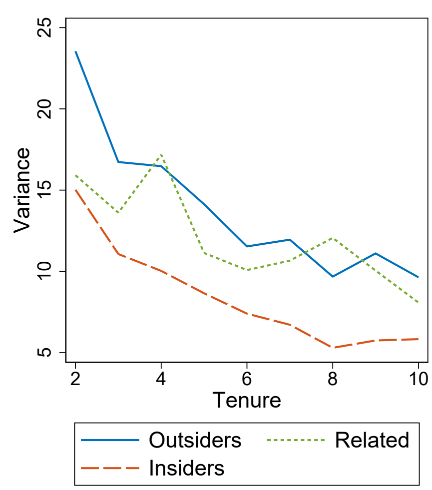
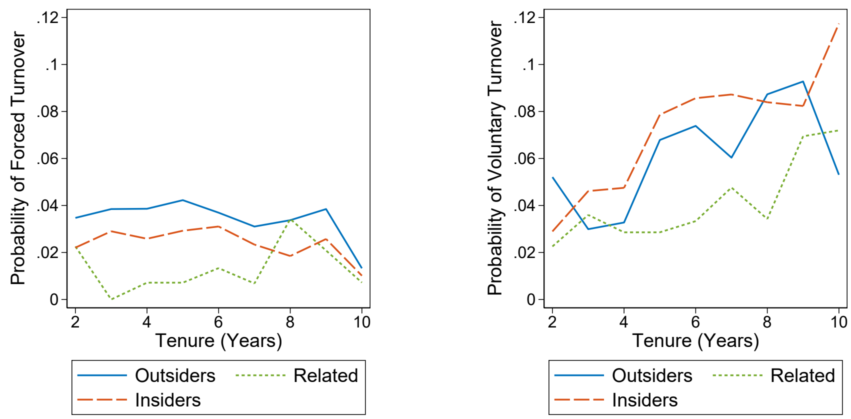


FIGURE 1: Variance of Cumulative Performance Residuals over Tenure
Notes: The cumulative performance residuals are defined in equation (2).

Related CEOs are rarely fired. Figure 2 plots the hazard rates of forced and voluntary turnover by CEO type during the first ten years of CEO tenure.[16] Consistent with Taylor (2010), the level of the hazards in Figure 2(a) shows that CEOs are very unlikely to be forced out across all levels of tenure. The probability of forced turnover is rather flat around four and three percent for outsiders and insiders, respectively, and it bounces between one and two percent for related executives. Figure 2(b) shows that while the likelihood of voluntary turnover steadily increases over tenure for all types of CEOs, related CEOs are generally less likely to step down voluntarily.



(a) Forced

(b) Voluntary

FIGURE 2: Forced and Voluntary Turnover Hazards

Notes: The hazards start at tenure two following our sample restrictions. In particular, we dropped one-year CEOs whose appointments are most likely interim.

The higher likelihood of forced turnover for outsiders is consistent with our previous results in Tables 1 and 2. Figure 3 suggests that those results are compounded with a higher sensitivity to fire based on performance in firms with outsider CEOs. The figure plots the evolution of performance residuals preceding forced turnover. It reveals that the cumulative performance residual persistently declines leading up to forced turnover for outsiders and insiders, especially for outsiders. For related CEOs the trend is rather flat. Forced turnover seems more sensitive to performance for outsiders and less sensitive for related CEOs.

Family-controlled firms are more likely to appoint related CEOs. Figure 4 shows the distribution of CEO types in family-controlled and non-family-controlled firms upon turnover. In both types of firms insiders are the most common hires (above 50%). Moreover, related CEOs are more than three times as likely to be hired in FC firms (15%) than in NFC firms (5%). That related CEOs are preferred in family-controlled firms is perhaps unsurprising since these companies likely

[16]The hazards start at tenure two following our sample restrictions described above. In particular, following Peréz-González (2006) we dropped one-year CEOs whose appointments are most likely interim.

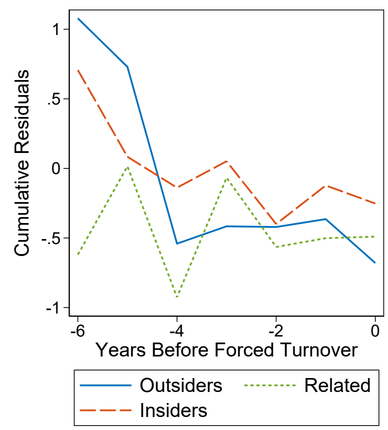


FIGURE 3: Performance Residuals Before Forced Turnover
Notes: This figure averages the cumulative performance residuals (defined in equation (2)) within each CEO type and shows how they trend preceding forced turnover.

display higher involvement of family members in firm operations, which increases the supply of related CEOs candidates. Moreover, conditional on supply, FC firms likely enjoy non-pecuniary benefits from keeping control within the family at the chief executive spot.

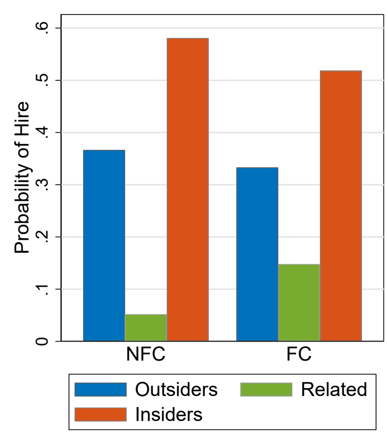


FIGURE 4: Distribution of CEOs Types by Firm Type, Conditional on Turnover
Notes: Firm types are non-family-controlled (NFC) and family-controlled (FC).

Early generations of related CEOs have higher residual firm performance. Firms in our sample hire related CEOs 18 percent of the time when the previous CEO was also related, yet they only hire related CEOs 2 or 3 percent of the time if the previous CEO was an outsider or insider, respectively. Figure 5 shows that these rather frequent related successions may not be strictly motivated by managerial quality. Focusing on related CEOs who had an unrelated predecessor (denoted *generation N*) and on their related successors (denoted *generation* $N+1$), Figure 5 plots the histogram of proxied CEO quality for these successive generations.[17] It shows a leftward shift in managerial quality from the initial related CEO to their successor. This pattern is consistent with Bloom et al. (2010) who argue that passing firm control from one family generation to the next can harm firm performance, and with Peréz-González (2006) who suggest that hiring decisions may depend less on the perceived quality of managerial candidates when positions are awarded by inheritance (preference) rather than merit.

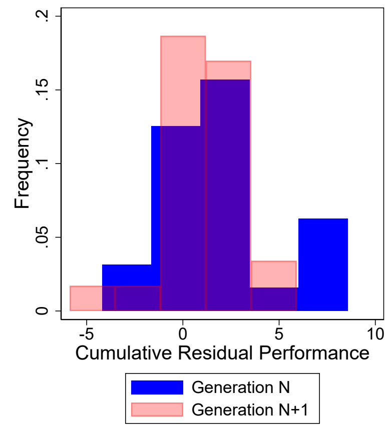


FIGURE 5: Quality of Successive Related CEOs

Notes: The Figure shows the distribution of our proxy of CEO quality for current related CEOs (*Generation N*) and their related successors (*Generation N+1*). Our proxy for CEO quality is the cumulative performance residual $\hat{\theta}_{jit}$ in the last year of the CEO's tenure, which is defined in equation (2). To mitigate the influence of outliers, we winsorize the cumulative residual distribution at the 1st and 99th percentiles.

3 A Model of CEO Turnover with Nepotism

The model features infinitely lived firms which can be family-controlled or non-family-controlled. Each firm's board of directors makes CEO firing and hiring decisions based on the executive's contribution to firm profits and on non-pecuniary benefits resulting from the CEO's familial ties to the firm. The board learns the match quality of its CEO over the executive's tenure and decides whether to fire them if the beliefs about their quality have deteriorated enough. CEOs can also leave the company voluntarily. Upon turnover, the board hires a replacement from one of three mutually exclusive pools of CEO candidates: outsiders, insiders, and related. Related CEOs have family ties to the firm. Insider CEOs do not have family ties to the firm, but were employees of the company who have ascended to the CEO spot. Outsiders do not have family ties to the firm and were not employees of the company. The firm has more prior information about the quality of insider and related candidates, reflecting previous interactions with them. FC and NFC firms differ in their availability of related CEO candidates.

[17] CEO quality is proxied by the cumulative performance residual $\hat{\theta}_{jit}$, as defined in equation (2), computed in the last year of the CEO's tenure.

3.1 Firms and Executives

Firms are indexed by i and time is indexed by t. CEOs serve in one single firm and drop from the pool of candidates upon turnover.[18] CEOs are indexed by j and have four main traits: age, type (determined by their prior relation to the firm), match quality, and tenure. Let $a_{jit} \in \mathbf{Z}_+$ denote the age of CEO j in firm i at t, and let $m_{ji} \in \{O, I, R\}$ denote their type, which can be outsider ($m_{ji} = O$), insider ($m_{ji} = I$) or related ($m_{ji} = R$). Let $\theta_{ji} \in \mathbf{R}$ denote the match quality of CEO j at firm i, and let $\tau_{jit} \in \mathbf{Z}_+$ denote their tenure as CEO. Both CEO match quality and type remain constant within the executive's spell at the firm. The age and match quality of CEO candidates are random variables with population cumulative distribution functions F_a and $N(\mu_\theta, \sigma_\theta^2)$, respectively.

Firms are infinitely lived. Their main trait is their type, denoted $\varphi_i \in \{0,1\}$, which can be either family-controlled ($\varphi_i = 1$) or non-family-controlled ($\varphi_i = 0$). Let $\nu_{it} \in \{0,1\}$ and $d_{it}^f \in \{0,1\}$ be indicators for voluntary turnover (stepping down) and forced turnover (firing), respectively. If a voluntary separation has not happened at the beginning of t ($\nu_{it} = 0$), the board of directors decides whether to fire their current CEO ($d_{it}^f = 1$) or retain them ($d_{it}^f = 0$). If a voluntary separation has happened ($\nu_{it} = 1$), or if the CEO was fired, the board decides the new CEO's prior relation, and draws their age and match quality. Both types of firms can always draw an outsider or an insider from their internal talent. However, they differ in the availability of related candidates, which happens with probability $p(\varphi_i)$. Upon turnover, and given related candidate availability, the hiring choice set of firm i at t is denoted $\mathscr{C}_{it} \subseteq \{O, I, R\}$. The firm must choose an executive and can only choose one.

3.2 Profitability and Information Structure

Firm profitability is denoted by Y_{jit} and has two components:

$$Y_{jit} = \iota_{it} + y_{jit} \tag{3}$$

where ι_{it} is an exogenous, industry-specific time trend. y_{jit} captures the *firm-specific* component of profitability which mean-reverts around the executive's match quality and is otherwise determined by turnover costs according to:[19]

$$y_{jit} = y_{it-1} + \rho(\theta_{ji} - y_{it-1}) - c(\nu_{it} + d_{it}^f) + \eta_{it} \tag{4}$$

[18] In the data only 91 out of 4,428 executives serve as CEO in more than one firm during the sample period.

[19] Following Taylor (2010) we omit tenure from the profitability equation. We tested in preliminary OLS and fixed effects regressions whether CEO tenure had an effect on firm profitability controlling for lagged profitability. We could not reject a zero coefficient. (See Table A.1 in Appendix A.2.)

where ρ measures the persistence of firm profitability and c is a monetary cost of turnover which reflects severance payments, recruitment costs, management disruptions, and other aspects of CEO turnover impacting profitability. Firm profitability also depends on an idiosyncratic shock η_{it} distributed $N(0,\sigma_\eta^2)$ independent across firms and periods.[20] Firms do not separately observe their CEO's match quality θ_{ji} from the idiosyncratic shock. Instead they observe the residual profitability $\xi_{jit} \equiv \theta_{jit} + \eta_{it}$ which they use as a signal to update their beliefs about their executive's match quality.

Let B_{jit} denote the firm's beliefs about the quality of its current CEO j, and let B^0_{kit} denote the prior beliefs the firm has before hiring a CEO candidate from pool $k \in \mathscr{C}_{it}$. Firms have rational expectations. Hence, since the board has no additional previous information regarding outsider candidates, the initial belief for outsiders is the population distribution of quality of CEO candidates. Regarding insider and related candidates, firms do have additional previous information by virtue of their previous professional or familial relations with the candidates. Upon turnover, firms obtain separate initial signals s_{Iit} about the quality of the next insider candidate and s_{Rit} about the next related candidate provided one is available, and update their beliefs using Bayes' Rule. Both signals are independently distributed $N(\theta_{kit},\sigma_s^2)$ over types of CEOs, time, and firms, where θ_{kit} is the quality of candidate of type k in firm i at time t, and σ_s^2 represents the quality of the additional information. Since the quality of CEO candidates and the signals are both distributed Normal, the initial beliefs for insider and related candidates are also distributed Normal. Hence, initial beliefs for each type of CEO are given by:

$$B^0_{kit} = \begin{cases} N\left(\mu_\theta,\sigma_\theta^2\right) & \text{if} \quad k=O \\ N\left(\frac{\sigma_s^2\mu_\theta+\sigma_\theta^2 s_{kit}}{\sigma_s^2+\sigma_\theta^2},\frac{\sigma_s^2\sigma_\theta^2}{\sigma_s^2+\sigma_\theta^2}\right) & \text{if} \quad k=I,R \end{cases} \tag{5}$$

The prior information received about insider and related candidates will favorably or negatively affect the firm's beliefs. This can be seen in equation (5). The signals change the mean of the distribution for insiders and related. In addition, the extra information decreases uncertainty about related and insider candidates since $\sigma_\theta^2 > \frac{\sigma_s^2\sigma_\theta^2}{\sigma_s^2+\sigma_\theta^2}$. In response to this changes in beliefs the board of directors will lean in favor of or against hiring outsiders.

Regarding their current CEO j, firms update beliefs in a similar fashion using the residual profitability signal ξ_{jit} which is distributed Normal by construction. Since the initial priors for all CEO types are also distributed Normal, the beliefs about the current CEO at any point in time are a Normal distribution which can be characterized by its mean $\tilde{\theta}_{jit}$ and variance $\tilde{\sigma}^2_{jit}$. We use this property to redefine the beliefs regarding the current CEO j as $B_{jit} \equiv [\tilde{\theta}_{jit},\tilde{\sigma}^2_{jit}]$, where by Bayes'

[20]We do not index prior profitability by the index j to capture the fact that the prior CEO may have been different.

Rule:

$$\tilde{\theta}_{jit+1} = \frac{\sigma_\eta^2 \tilde{\theta}_{jit} + \tilde{\sigma}_{jit}^2 \xi_{jit}}{\sigma_\eta^2 + \tilde{\sigma}_{jit}^2}; \qquad \tilde{\sigma}_{jit+1}^2 = \frac{\sigma_\eta^2 \tilde{\sigma}_{jit}^2}{\sigma_\eta^2 + \tilde{\sigma}_{jit}^2} \tag{6}$$

3.3 Firm Preferences and Turnover

The board of directors is forward-looking and discounts the future using the discount factor β. It is risk-neutral and has preferences over profits, the prior relation of its CEO, and forced turnover. Dollar profits in year t result from multiplying the firm's book value of assets b_{it} by its profitability Y_{ijt}. Note that the industry component of profitability ι_{it} is assumed to be exogenous and thus has no effect on decision making under the assumption of risk-neutrality. The firm's flow utility given CEO j is given by:

$$u_{jit} = b_{it}\left(Y_{jit} - d_{it}^f\left(\pi_0 + \pi_R \mathbf{1}\{m_{j-1,i} = R\}\right) + \pi_S(d_{it}^f + v_{it})\mathbf{1}\{m_{j-1i} = m_{ji} = R\}\right) \tag{7}$$

where $m_{j-1,i}$ stands for the type of the previous CEO upon turnover. The parameters π_0 and π_R capture the distaste for firing a CEO (*entrenchment*, as in Taylor (2010)); π_0 measures the firm's baseline distaste and π_R measures the additional distaste for firing related executives (*related entrenchment*). The parameter π_S captures the taste for related successions, which happen when in a turnover event both the previous and the newly hired executive are related CEOs. Nepotism is captured by both the differential cost of firing related CEOs π_R and the taste for related successions π_S. The parameters π_0, π_R, and π_S are a constant fraction of firm assets. This assumption allows nepotism to vary by firm size. We follow Taylor (2010) and assume that all profits are immediately paid out as dividends. Consequently, firm assets b_{it} are constant over time and do not affect the firm's decision problem.[21]

Additionally, the board faces two sets of preference shocks: a two-dimensional vector $\varepsilon_{it}^1 = \{\varepsilon_{0it}, \varepsilon_{1it}\}$ associated with its decision to retain (ε_{0it}) or fire (ε_{1it}) its current CEO, and a three-dimensional vector $\varepsilon_{it}^2 = \{\varepsilon_{Oit}, \varepsilon_{Iit}, \varepsilon_{Rit}\}$ associated with each of the three prior relations a new CEO can have with the firm. The vector ε_{it}^2 is only received if there is a turnover event. All preference shocks are distributed $Gumbel(0,1)$ independent across time, firms, and alternatives.

At the beginning of every period firms realize their draw of voluntary turnover v_{it}. The probability of voluntary turnover, denoted $g(a_{jit}, \tau_{jit}, m_{ji})$, depends on the age, tenure, and type of their current CEO. If voluntary turnover is avoided, firms update beliefs and receive the preference shock vector ε_{it}^1 before deciding whether to fire or retain their current CEO. Conditional on turnover and before deciding what type of CEO to hire, the board receives the preference shock vector ε_{it}^2, draws the availability of a related candidate according to $p(\varphi_i)$, and draws signals s_{kit}

[21] This assumption facilitates tractability as the evolution of firm assets does not need to be modeled.

for insider and related candidates.

We now characterize the optimal turnover and hiring decisions of the firm. Define the state of firm i, net of preference shocks, as $x_{it} \equiv (y_{it-1}, a_{jit}, m_{ji}, B_{jit}, \tau_{jit}, \varphi_i)$.[22] Suppose a turnover event has occurred, so that $v_{it} + d_{it}^f = 1$. Let $x_{it}^{(k)}$ be the firm's state induced by choosing a CEO of type k at t, which includes updated priors yielded from initial quality signals for insider and related candidates.[23] The firm decides which type of CEO to hire by solving:

$$\max_{k \in \mathscr{C}_{it}} \{V_0(x_{it}^{(k)}) + \varepsilon_{kit}^2\} \tag{8}$$

where $V_0(x_{it}^{(k)})$ is the conditional value of retaining a CEO evaluated at the firm's state $x_{it}^{(k)}$ resulting from choosing a CEO of type k. Using the hiring problem in (8) we can define the conditional value function of entering the hiring decision node, either by choice or by chance, as:

$$V_1(x_{it}) = -d_{it}^f \left(\pi_0 + \pi_R \mathbf{1}\{m_{ji} = R\}\right) + E\left[\max_{k \in \mathscr{C}_{it}} \{V_0(x_{it}^{(k)}) + \varepsilon_{kit}^2\} \middle| x_{it}\right] \tag{9}$$

Expectations are computed over the choice set $\mathscr{C}_{it}$ (i.e. over the availability of related candidates), over the prior signals of quality s_{kt}, over the age of CEO candidates, and over the vector of preference shocks ε_{it}^2. The conditional value function of entering the hiring node in (9) entails the possibility of optimally hiring a new CEO from the types that might be available, the monetary cost of turnover through its effect on current profitability, and the non-pecuniary cost of entrenchment.

At the beginning of the period, and provided voluntary turnover has not happened, the firm decides whether to retain or fire its current CEO by solving:

$$\max_{r \in \{0,1\}} \{V_r(x_{it}) + \varepsilon_{rit}^1\} \tag{10}$$

Using the firing optimization problem in (10), we recursively define the firm's conditional value function of having state x_{it} and retaining its CEO as:

$$\begin{aligned} V_0(x_{it}) \quad = \quad & E\Big\{ y_{jit} + \pi_S (d_{it}^f + v_{it}) \mathbf{1}\{m_{j-1i} = m_{ji} = R\} \\ & + \beta \left[g(x_{it}) V_1(x_{it+1}) + (1 - g(x_{it})) \max_{r \in \{0,1\}} \{V_r(x_{it+1}) + \varepsilon_{rit+1}^1\} \right] \Big| x_{it} \Big\} \end{aligned} \tag{11}$$

[22]We leave B_{jit} in the state of the firm's problem for notational simplicity. However, the mean of beliefs is sufficient as the variance of beliefs is a deterministic function of structural parameters, the type of the CEO, and their tenure. In estimation we omit the variance of the beliefs distribution from the state.

[23]For instance, if the firm chooses an outsider (a CEO of type O) the induced state will be $x_{it}^{(O)} = (y_{it-1}, a_{j'it}, m_{j'i} = O, B_{j'it} = B_{Oit}^0, \tau_{j'it} = 1, \varphi_i)$, where $j' \neq j$ is the index of the new CEO.

The conditional value function of retaining the current CEO includes profitability, dynastic preferences, the discounted conditional value of entering the hiring decision node next period due to voluntary turnover, and the discounted value of being at the firing decision node next period if voluntary turnover does not happen. The expectation is computed over profitability (using current beliefs), over future preference shocks ε^1_{it+1}, and over the future state x_{it+1}.

3.4 Further Model Details

To decrease the size of the state, we discretize CEO age a_{jit} into five categories: less than 40, $[40,59]$, $[60,64]$, $[65,79]$, and 80 or more. The distribution of new CEO age F_a is obtained as the empirical distribution given these categories, and is the same for all types of CEOs. We let the categorized age a_{jit} evolve stochastically according to the empirical, upper-diagonal transition matrix. (See Appendix A.2) The probability of voluntary turnover g depends on a flexible index function $\tilde{g}$ of CEO age, tenure, and type, and it also captures retirement:

$$g(x_{it}) = \begin{cases} 1 & \text{if} \quad a_{jit} >= 80 \\ \frac{exp(\tilde{g}(a_{jit},\tau_{jit},m_{ji}))}{1+exp(\tilde{g}(a_{jit},\tau_{jit},m_{ji}))} & \text{otherwise} \end{cases} \tag{12}$$

The probability of available related CEO candidates is given by:

$$p(\varphi_i) = \begin{cases} p_0 & \text{if} \quad \varphi_i = 0 \text{ (non-family-controlled)} \\ p_0 + \Delta_p, \ \ \Delta_p > 0 & \text{if} \quad \varphi_i = 1 \text{ (family-controlled)} \end{cases} \tag{13}$$

where Δ_p is the additional probability of available related CEO candidates in family-controlled firms; the constraint $\Delta_p > 0$ captures the fact that family-controlled firms by their nature have more readily available pools of related CEO candidates than non-family-controlled firms. Finally, we assume that the discount factor is $\beta = 0.9$ following Taylor (2010).

4 Identification and Estimation

There are five sets of parameters to be identified in the model: learning structure, voluntary turnover, profitability, utility, and CEO availability. The sources of variation that identify these parameters are observed profitability and observed turnover (voluntary and forced) over time, as well as CEO characteristics (tenure as CEO, prior relation to the firm, and age) and firm type (family-controlled or not).

The panel of profitability and firm-CEO matches, together with our assumptions of Bayesian learning and rational expectations help identify the parameters of the underlying distribution of

CEO match quality. The rational expectations assumption anchors initial beliefs for all executives which allows the persistent unexplained variation in profitability across firm-CEO matches to identify the parameters of the underlying distribution. Notably, since we do not include a constant term in the profitability equation in (4) we are able to use this variation to identify not only the variance of the distribution (σ_θ^2) but also the mean (μ_θ). Identification of the variance of the insider and related signals (σ_s^2) relies on differences in profitability between CEOs with prior relationships to the firm (insiders or related) and those without (outsiders). Identification of σ_s^2 is aided by the exclusion restriction that a CEO's prior relationship to the firm does not have a direct effect on firm profitability, which is supported by the null impact of tenure on firm performance we found in reduced form (Table A.1 in Appendix A.2.).

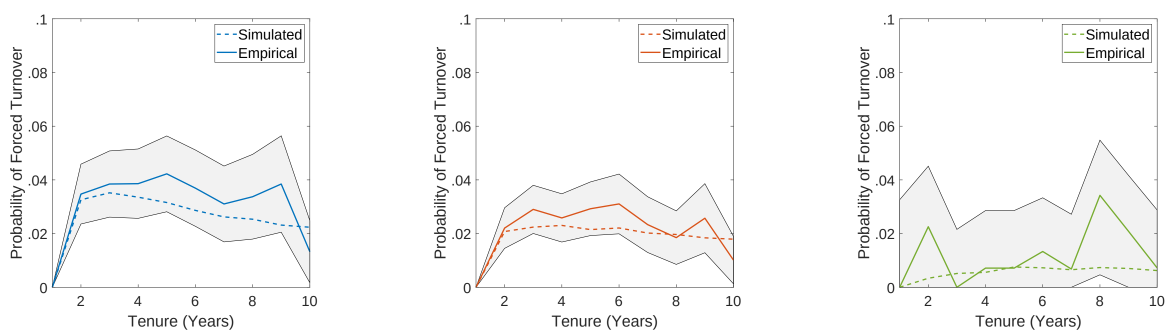
Identification of the parameters of the index function $\tilde{g}$ in equation (12), which determines the probability of voluntary turnover, relies on variation in voluntary turnover rates by CEO tenure, age, and type. Since CEO type and tenure are endogenous to beliefs, our identifying assumption is that voluntary separation does not depend on beliefs after controlling for age, type, and tenure. This is consistent with CEOs voluntary separation decisions being driven by retirement concerns due to age, on-the-job exhaustion and preferences for change due to tenure, and firm loyalty due to CEO type, and not by beliefs about their match quality at the current firm. This is consistent with our reduced form findings in Table 1.

The persistence parameter (ρ) is identified off of the persistence in profitability across firms in the panel. The monetary cost of turnover (c) is identified off of changes in profitability around turnover events. Since turnover is endogenous it is fundamental for identification of c that we model the firing decision to account for the selection process based on unobserved, time-varying beliefs about CEO match quality. The variance in profitability shocks (σ_η^2) is identified using the residual idiosyncratic variation in profitability across all firms and years, after removing profitability persistence, turnover effects, and unobserved persistence within firm-CEO matches.

Identification of the flow payoffs is standard following results in Magnac and Thesmar (2002) and Arcidiacono and Miller (2020). Given the assumed two-step structure of the problem (first firing, then hiring), the distribution of alternative-specific taste shocks, the subjective discount factor, the voluntary turnover transition function, and the transition function of beliefs implied by equations (5) and (6), non-pecuniary payoffs from entrenchment (π_0, π_R) and related successions (π_S) are identified up to the normalization that the flow payoff from retaining a CEO only depends on profitability. Importantly, we normalize the coefficient of profitability to one. Hence, the risk-neutral boards of directors in firms of both types (FC or NFC) with all types of CEOs (related, insider, or outsiders) value profitability identically as a share of assets. Identification of the entrenchment parameters (π_0, π_R) relies on firing rates across all firms, for all CEOs and specifically for related CEOs. Identification of the taste for related successions (π_S) relies on the proportion of related-to-related transitions upon turnover.

Finally, since we do not observe the supply of related candidates the probabilities of available related candidates (p_0, Δ_p) are essentially mixture parameters. To aid identification of these probabilities separate from the payoff parameters associated with related CEOs (π_R and π_S), we first exploit differences in firm type by imposing the constraint that the probability of available, related CEO candidates in FC firms is higher than the probability in NFC firms (i.e. by imposing $\Delta_p > 0$). Under this constraint, identification of p_0 relies on the hiring rates of related executives in NFC firms and identification of Δ_p relies on differences in hiring rates of related executives between FC and NFC firms.

Estimation of the model entails two stages. In the first stage we estimate the parameters of the process of voluntary turnover in a logistic regression. Given these parameters we use Simulated Method of Moments (SMM) to estimate the remaining parameters of the model.[24] Overall, we use twenty-five moments for estimation, which include: the coefficients of an AR(1) regression of profitability controlling for the CEO's prior relation to the firm, and recent turnover episodes; the coefficients of a regression of forced turnover on tenure and tenure interacted with the CEO's prior relation to the firm; proportions of insider and related CEOs by firm-type; the variance across CEO spells of the within-spell mean of residual profitability; and the mean across CEO spells of the within-spell variance of residual profitability. Second stage standard errors are corrected for the two-stage process following Newey and McFadden (1994). See Appendix A.3 for a more detailed description of the estimation process.



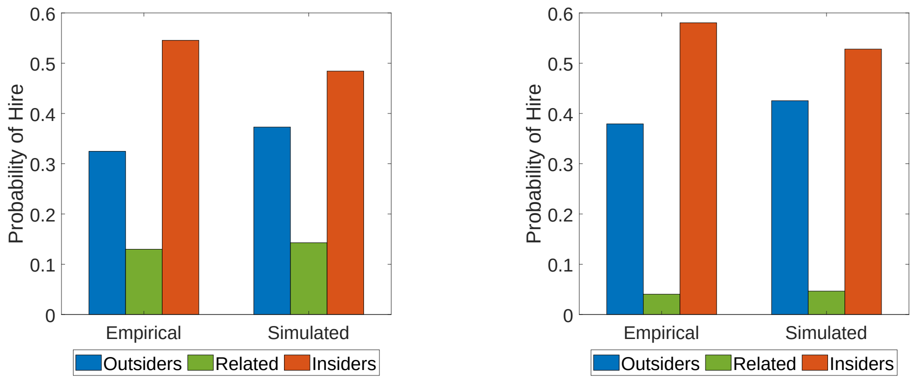
(a) Outsiders (b) Insiders (c) Related

FIGURE 6: Model Fit: Forced Turnover Hazards

Notes: Solid lines denote the empirical rates while dashed lines denote the simulated one. The gray shaded region indicates the 95 percent confidence intervals around the empirical rates.

The model fits the data very well in both the firing and hiring margins. Figure 6 compares

[24] We simulate the model twenty times on each iteration of the estimation algorithm. The weighting matrix for estimation is the inverse of the variance-covariance matrix of the vector of moments, which is the sample counterpart of the optimal weighting matrix.



(a) Family-controlled　　(b) Non-family-controlled

FIGURE 7: Model Fit: CEO Hiring Shares Conditional on Turnover
Notes: Figure shows the empirical and simulated hiring probabilities for each firm type, conditional on a turnover event.

simulated and empirical firing hazards for each type of CEO. The simulated hazards capture well the level and trend of the empirical hazards, and they lie within the 95 percent confidence interval of the empirical hazards for all levels of tenure and for all types of CEOs. Figure 7 compares simulated and observed hiring proportions of CEO types across firm types. The model is able to generate very closely the hiring rates of all types of CEOs across both types of firms. Importantly, the model is able to generate the differences in hiring rates of related CEOs between FC and NFC firms. Additional measures of model fit can be found in Appendix A.3.

5 Structural Estimates

Table 4 presents our main structural estimates and we relegate to Appendix A.4 our estimates of the probability of voluntary turnover. (Importantly, voluntary turnover is significantly less likely among related CEOs than among insiders or outsiders.) The value of ρ in Table 4 implies a high profitability persistence of $0.812 = 1-\rho$. The estimated probability of the availability of related candidates in non-family-controlled firms (0.102) suggests a rather low supply. This probability roughly triples ($p_0 + \Delta_p = .299$) for family-controlled firms.

μ_θ	σ^2_θ	σ^2_η	σ^2_{sI}	σ^2_{sR}	ρ	c	π_0	π_R	π_S	p_0	Δ_p
-.007	6.13	41.1	9.26	9.87	.188	1.46	12.3	4.61	4.96	.102	.197
($3.7e^{-4}$)	(.036)	(.025)	(2.56)	(1.75)	(.011)	(.246)	(2.15)	(.814)	(.730)	($1.9e^{-4}$)	(.089)

TABLE 4: Parameter Estimates
Notes: Standard errors in parentheses are corrected for two-stage estimation. Additional details can be found in Appendix A.3.3.

In order to interpret the rest of the parameters first recall that the units of the firm's flow utility are in percent of assets (ROA). Hence, multiplying each coefficient by the median firm's assets ($2.1 billion for the median firm) yields the implied value for the median firm. The estimated average match quality in the population of CEO candidates is equivalent to a decrease of $\rho \cdot \mu_\theta \approx -.001$ percent of assets per year, or about $.03 million per year. Focusing on the second moment, the estimated variance of the candidate distribution implies that a standard deviation increase in match quality corresponds to an increase in profitability of approximately $\sigma_\theta \cdot \rho \approx 0.47$ percent of assets per year, or about $9.98 million. The high value of σ_η^2 relative to σ_θ^2 implies that the dispersion in the match quality of CEO candidates is much lower than the idiosyncratic dispersion in profitability. A one standard deviation increase in idiosyncratic profitability corresponds to an increase in profitability of approximately $\sigma_\eta \cdot \rho \approx 1.21$ percent of assets per year, or about $25.9 million.

The pecuniary costs associated with forced turnover are estimated to be 1.46 percent of assets which is about $30.7 million for the median firm. These costs include things such as severance payments, the costs of recruiting a replacement CEO, costs associated with management or strategic changes, and lower level turnover which may follow the departure of a chief executive. The estimate of the board's non-pecuniary baseline cost of turnover is significantly higher, 12.3 percent of total assets or about $258.3 million for the median firm. Hence, firms appear to have a very high distaste for firing a CEO. While our estimated monetary costs of firing are very close to those reported in Taylor (2010), our estimated non-pecuniary costs are nearly three times as large. This is in part due to the fact that we incorporate the different pools of executive talent that firms may have available (outsiders, insiders, related). As the board faces more pools of talent, the option value of turnover increases; hence, the estimated cost of turnover must increase to rationalize the low rates of forced turnover in the data. Adding all costs from firing a related CEO (c, π_0, π_R) yields a total equivalent of $385.8 million for the median firm.

5.1 Information Quality and The Speed of Learning

As firms receive more and more signals over an executive's tenure the variance of beliefs is reduced, gradually revealing the executive's match quality. The high value of idiosyncratic variation in ROA (σ_η^2) relative to the quality of signals received before hiring a candidate ($\sigma_{sI}^2, \sigma_{sR}^2$) implies that the prior information available regarding related and insider CEO candidates has lower noise than the information signals received from an incumbent CEO. On the one hand, absent any prior signals, the prior variance after receiving one signal on the job as CEO is $\sigma_\theta^2 \sigma_\eta^2 / (\sigma_\theta^2 + \sigma_\eta^2) \approx 5.33$. On the other, the prior variance after receiving a prior-relation signal ($s_k, k \in \{I, R\}$) is $\sigma_\theta^2 \sigma_{sI}^2 / (\sigma_\theta^2 + \sigma_{sI}^2) \approx 3.69$ for insider candidates and $\sigma_\theta^2 \sigma_{sI}^2 / (\sigma_\theta^2 + \sigma_{sI}^2) \approx 3.78$ for related candidates. Moreover, since σ_θ^2 is the board's prior variance of beliefs over the quality of outsider

CEOs, our estimates imply that the board faces approximately 66 percent more uncertainty when hiring outsiders (6.13) than when hiring insider or related candidates.

To get a sense of the speed at which boards obtain information about their CEOs, Figure 8 plots the percent of uncertainty remaining as tenure increases.[25] Since the estimated information structure for insider and related CEOs is very similar (σ_{sI}^2 is very close to σ_{sR}^2), so is the speed of learning for these two types of CEOs. The large noise in the productivity signals due to the large idiosyncratic variation σ_η^2 causes the learning process to happen rather slowly. For outsider CEOs, more than half of the uncertainty still remains after 5 years of tenure. For insider and related CEOs, roughly 40 percent of the uncertainty is eliminated upon hire given the firm's additional information obtained in previous interactions with the candidate. Compare this with the roughly 13 percent drop in uncertainty following the first year of tenure for outsider CEOs. Figure 8 suggests that prior interactions with insider and related executive candidates have the same information content as roughly 6 years of CEO tenure without any prior information.

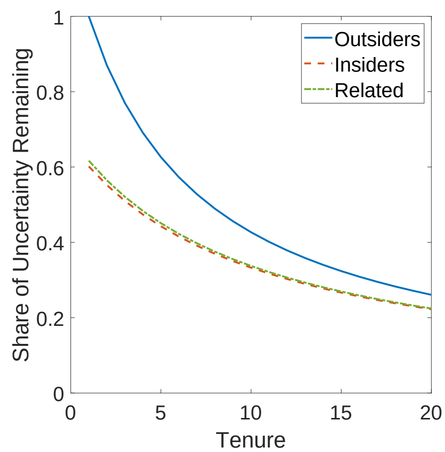


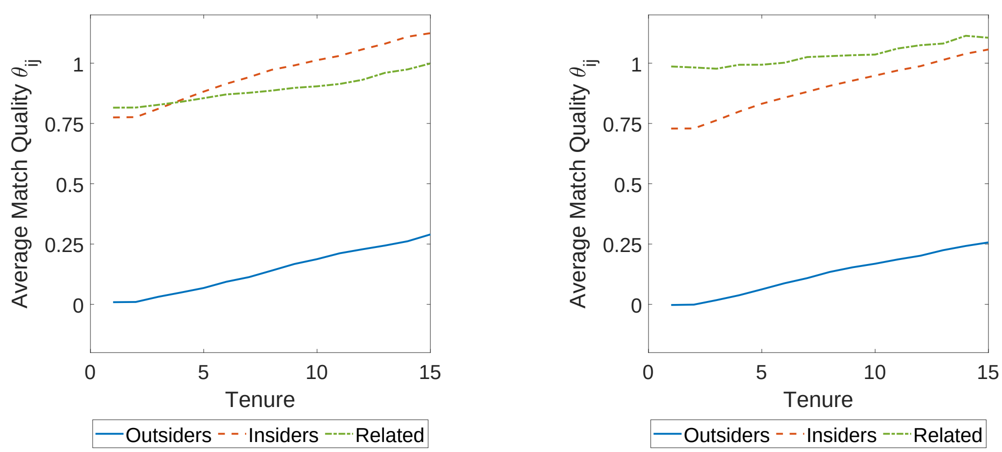
FIGURE 8: Uncertainty Reduction over Tenure
Notes: Remaining uncertainty is the ratio of the variance of beliefs at tenure t to the variance of the population distribution of quality of CEO candidates, $\tilde{\sigma}_{jit}^2/\sigma_\theta^2$.

The presence of information frictions also creates differences in the evolution of the quality of firm executives. These differences emerge from the way in which information drives the board of director's hiring and firing decisions. To illustrate, Figure 9 plots the average quality of CEOs over tenure by firm and executive type. The differences in initial match quality across CEO types shown in the figure highlight the value of the additional prior information firms acquire on insider and related candidates before hiring. By contrast, the lower initial average quality of outsiders follows from the fact that firms do not have prior interactions with the candidates that can result in

[25]Remaining uncertainty is computed as $\tilde{\sigma}_{jit}^2/\sigma_\theta^2$, which is the variance of beliefs at tenure t as a proportion of the variance of the population distribution of quality of CEO candidates.

better matched executives. For the median sized FC firm, the average outsider CEO initially yields \$1.7 million and \$2.2 million less in cash flows per year when compared with insider and related CEOs, respectively. For the median NFC firm, the average outsider yields \$2.5 million and \$3.6 million less in cash flows per year when compared with insider and related CEOs, respectively. For NFC firms, the initial quality of related CEOs is the highest because these firms are less likely to have related candidates available and hence are less likely to enjoy non-pecuniary dynastic benefits from related-to-related transitions. This causes NFC firms to be more selective of their related candidates at the hiring margin.

As tenure increases, Figure 9 reveals the extent to which firms exercise their ability to select through firing as they acquire information. The positive relationship between average match quality and tenure, regardless of firm or CEO type, shows that better matched CEOs are more likely to survive in their positions. This selection effect is more pronounced for outsider and insider CEOs. By contrast, the relationship between average match quality and tenure is weaker for related CEOs due to the higher estimated non-pecuniary cost of firing these executives. The match quality-tenure gradient for related CEOs is steeper in FC firms, since they are more likely to have a related candidate available for related-to-related transitions, which counteracts the related entrenchment effect.



(a) Family-controlled (b) Non-family-controlled

FIGURE 9: Positive Selection over Tenure

Notes: Figure plots the average match quality of each type of CEO over the first 15 years of tenure.

5.2 Dynastic Preferences

Boards of directors in firms with related CEOs obtain dynastic non-pecuniary benefits π_S that amount to 4.96 percent of total assets (or about $104.2 million for the median firm) if they undertake family-to-family successions by hiring a new related CEO upon facing a turnover event. This suggests that conditional on the departure of a related CEO, firms have significant preference for handing managerial control to a later generation of family. Following the departure of a related CEO, firms face a trade-off between CEO match quality and the non-pecuniary benefits of employing successive related CEOs. Due to the presence of such non-pecuniary benefits, firms are willing to forego some match quality in exchange for employing a related CEO. As a result, later generations of related CEOs tend to be of lower quality than their predecessors. Figure 10 plots the CDF of related CEO match quality split by predecessor generations and their immediate successors. The CDF of related successor quality lies strictly to the left of the predecessor counterpart, signifying a decline in quality (in a stochastic sense). Such a preference comes directly at the expense of firm performance. This result is consistent with findings in the empirical literature (Peréz-González, 2006; Bloom et al., 2010; Bennedsen et al., 2007), suggesting that inherited firm control leads to a deterioration of managerial quality and firm performance.

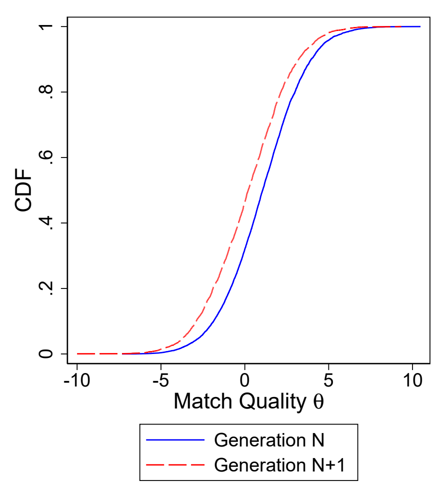


FIGURE 10: CEO Quality Across Family Generations
Notes: Figure 10 plots the cumulative distribution of predecessor related CEOs (*Generation N*) and their immediate successors (*Generation $N+1$*).

6 Anti-Nepotism Policies and Firm Value

In this section we assess the impact of anti-nepotism policies on the performance of family-controlled and non-family-controlled firms as reflected in their net present value (NPV). In our model, anti-nepotism policies can impact firm performance by reducing the pool of talent, by exposing the firm to more uncertainty (as related candidates have prior, information-revealing interactions with the firm), by increasing the probability of voluntary turnover (as related CEOs are less likely to leave voluntarily), by preventing firms from incurring related entrenchment costs upon firing family, and by preventing firms from obtaining dynastic non-pecuniary benefits from family-to-family successions. To implement the policies and compare them to the baseline we first replicate all firms in the sample who underwent a turnover event (67 FC and 1674 NFC firms). We then let these firms operate under the baseline and under the counterfactual policies for the length of our sample (18 years) starting from an instance of turnover, so that all CEOs start with the same tenure. We simulate each of the replicated firms 100 times in the baseline and counterfactual environments. We study two policies that vary in the strength with which they limit nepotism at the top management echelon. First, we impose a mandate under which firms are forbidden from hiring related CEOs. This allows us to assess the net impact of eliminating this pool of executive talent. Second, we consider a weaker anti-nepotism policy that prohibits dynastic, family-to-family successions of chief executives, which responds to the empirical fact that related successors tend to be less able. Results from both policies are summarized in Table 5.

TABLE 5: Summary of Counterfactual Results

	Panel A: Family-Controlled Firms			*Panel B: Non-Family-Controlled Firms*		
	Baseline	Mandate	No Family Successions	Baseline	Mandate	No Family Successions
NPV ($1 billion)	18.4	17.5	18.8	16.0	15.6	16.2
%Δ NPV		-4.80	2.31		-2.14	1.67
$Pr(outsider)$	.248	.360	.273	.418	.440	.428
$Pr(insider)$	.569	.640	.636	.547	.560	.532
$Pr(related)$	.184	0	.091	.035	0	.040

Notes: *Columns*: *Mandate* corresponds to a counterfactual regime in which related hires are forbidden; *No Family Successions* corresponds to a regime in which related-to-related CEO transitions are forbidden.

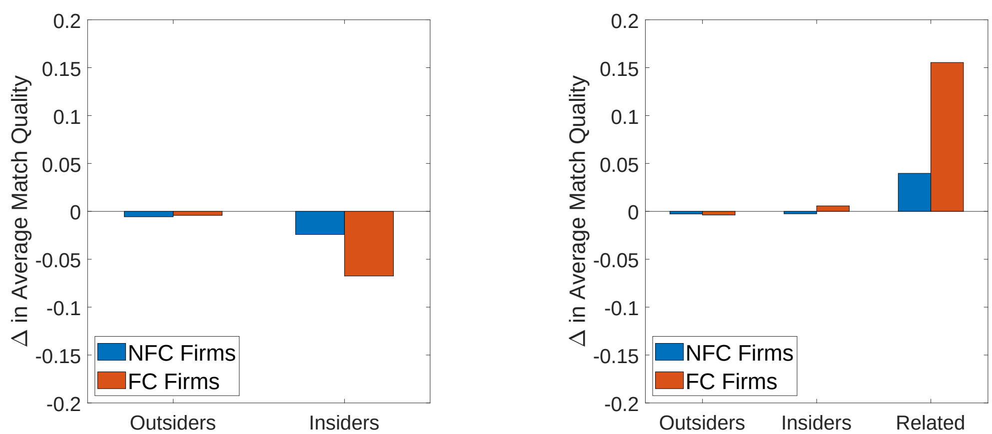
6.1 A Mandate that Prohibits Family CEOs

In this counterfactual we prevent firms from accessing their pool of related candidates.[26] Because firms have distinct preferences regarding related CEOs at the firing and hiring margins, it is possible that a mandate that prevents firms from hiring family increases firm performance by preventing boards from making personnel choices based on their preferences for related executives. However, removing the pool of related candidates releases some of the competitive pressure at the hiring margin reducing the threshold of expected quality necessary to hire insider candidates. These

[26]The mandate effectively sets the supply probabilities (p_0 and Δ_p) equal to zero for both FC and NFC firms.

countervailing forces make ambiguous the net effect on firm present value of a strict anti-nepotism policy like the one implemented in this section.

Table 5 shows the effects of the mandate on NPV relative to the baseline. NPV decreases by 2.1 percent in NFC firms and by 4.8 percent in FC firms. Since family-controlled firms are more likely to have related CEOs available for hire, the mandate is less restrictive for NFC firms. This result reveals that the value of the pool of related CEOs as a source of selected talent dominates the potential negative effects on NPV from related entrenchment. The decline in NPV is due to the fact that firms can no longer be as selective. This mechanism is illustrated in Figure 11(a). The mandate strictly lowers the average quality of insider CEOs at the hiring margin and, by construction, it has no effect on the average quality of outsider CEOs.[27] This effect is compounded by the fact that insiders are now more likely to be hired than in the baseline (.640 vs .569). Eliminating the supply of related CEO candidates also increases the probability of hiring an outsider CEO from 0.248 to 0.360, implying that firms do not fully substitute their share of related hires in the baseline with insider hires under the counterfactual. Figure 9 indicates that this increased exposure to outsiders comes with a decrease in the quality of executives as firms cannot exercise their selectivity in the absence of prior information. Overall, the anti-nepotism mandate reduces profits, particularly for FC firms that have greater supply of related candidates.



(a) Mandate

(b) No Family Successions

FIGURE 11: Match Quality under Counterfactual Policies

Notes: *Columns*: *Mandate* corresponds to a counterfactual regime in which related hires are forbidden; *No Family Successions* corresponds to a regime in which related-to-related CEO transitions are forbidden.

[27] The expected value of quality of outsider CEOs at the hiring margin does not change as they are selected with no additional prior information in both, the baseline and the counterfactuals.

6.2 A Policy that Prohibits Family-to-Family CEO Successions

We next consider a policy that is less restrictive than the mandate of the previous section. In this counterfactual related CEOs cannot have a related successor. Under this policy firms with related CEOs face a restricted choice set but firms with outsider or insider executives are free to hire a related candidate should one be available.[28] While the more restrictive mandate induced a sizable decrease in firm NPV, this milder restriction on familial successions has a positive effect. NPV increases by 2.3 percent and 1.7 percent for FC and NFC firms, respectively. This result suggests that a milder policy can increase firm value by reigning in familial preferences without completely eliminating the value of having an additional pool of talent available.

The key mechanism at work is illustrated in Figure 11(b). Insider match qualities are largely unaffected, while the match qualities of related CEOs substantially increase, especially for family-controlled firms. (Here again, the average quality of outsiders at the hiring margin does not change.) Two channels drive this increase in related executive quality. First, this policy makes hiring a related CEO less attractive because it subjects the firm to future hiring restrictions. To compensate for this, the threshold of expected quality necessary for a related CEO to be hired must increase. The rebalancing of CEO hires in panel B of Table 5 suggests that this channel must be strong because while the share of related hires slightly increases in NFC firms, it decreases by half in FC firms as supply of related successors is restricted. Second, dynastic preferences lead firms to trade off related CEO quality in exchange for the non-pecuniary benefits associated with hiring the next generation of family. This is illustrated in Figures 5 and 10, where we observe a decrease in the quality of successive family generations. Since this channel is eliminated when family successions are prohibited, the average match quality of related CEOs increases. We conclude from this section that while blanket anti-nepotism policies may be harmful to the firm by eliminating a valuable pool of talent, targeted policies that specifically address pro-family biases may be beneficial.

7 Conclusion

To study the impact of nepotism on firm performance and personnel decisions we provide a structural framework in which firms select among various types of CEOs and the contribution of a firm's executive to its performance is revealed over time. There are two important effects that stem from having a pool of related candidates: a direct effect on the expected quality of related executive hires induced by preferences for related successors, and an indirect dynamic effect due to entrenchment

[28] Firms with related CEOs in period $t-1$ which enter the hiring node in period t face the deterministic choice set $\mathscr{C}'_{it} = \{O, I\}$. Otherwise, hiring firms face the typical stochastic choice set $\mathscr{C}_{it}$ which can include a related candidate if their availability is realized. Otherwise the model mechanics remain unchanged.

in firm turnover decisions. We show that the presence of related CEO candidates increases firms' selectivity when evaluating unrelated candidates, which boosts performance. Moreover, as family-controlled firms have a greater pool of related talent, they benefit more from the stricter dynamic selection induced by the pool of related candidates. Given these opposing effects, we find that an outright ban on related CEOs is harmful to firm value while a mild restriction on related-to-related successions is value-enhancing. When firms have dynastic preferences, they trade off executive quality for the non-pecuniary benefits associated with appointing a successive generation of family as CEO. We find that eliminating these types of successions leads to an increase in firm net present value.

We also show that firms significantly reduce their exposure to uncertainty when they hire internally (either insider or related executives). Previous interactions between the firm and internal executive candidates reveal a substantial amount of information regarding the executive's contribution to firm performance. Firms who hire externally face roughly 66 percent more uncertainty, and over half of this uncertainty remains after 5 years of CEO tenure. We find that the uncertainty reduced by virtue of previous interactions between the firm and internal executive candidates is equivalent to the uncertainty reduced over 6 years of tenure for an outsider CEO.

Throughout the paper, we restrict attention to large, publicly-traded firms. An important extension to our empirical approach, which we do not currently pursue given data limitations, would be to study the behavior and performance of privately-held firms. Several papers, Bertrand and Schoar (2006) and Claessens et al. (2000) for example, document that family-controlled firms tend to be privately held and smaller than average. It is plausible that nepotism is a stronger determinant of personnel decisions and firm performance in these smaller firms. Another extension of the model would be to incorporate CEO pay to the framework. The entrenchment of related CEOs decreases their risk of being fired, which may increase the cost of incentive alignment. Additionally, uncertainty about the CEO contribution to firm performance may have consequences for the form of the optimal contract (Prat and Jovanovic, 2014; Demarzo and Sannikov, 2017). This would significantly complicate the model presented here, so we leave this application for future research.

A Appendix

A.1 Data Appendix

Compustat Data. We obtain company fundamentals data from Compustat North America, which contains a rich set of financial information on publicly held companies in Canada and the U.S. Using operating income before depreciation (item *oibdp*) and total assets (item *at*) we compute return on assets (ROA_{ijt}) for each firm-year as:

$$ROA_{ijt} = \frac{2 * oibdp_t}{at_t + at_{t-1}}$$

In the estimation and descriptive sections, we report results using the industry-adjusted ROA, which is simply ROA_{ijt} demeaned by industry-year. Industries are defined using the Standard Industry Classification (SIC) codes. We group firms by major SIC classification, which yields nine industries.[29] We drop observations for which year, operating income before deprecation, or total assets are not reported (67,897 observations). For firms with gaps in records (i.e. one or more years in their time series are missing), we drop the firm's record after the first gap (4,779 observations).

Execucomp data. We obtain data on CEO tenure, pay, and demographic information from Execucomp. Compustat and Execucomp uniquely identify firms using the ID *gvkey* and executives using the ID *execid*. Execucomp reports both the dates an executive joined the company and the date they became CEO. We use this in the definition of an insider:

$$\text{Insider CEO} \iff \text{Year became CEO} - \text{Year joined company} > 2$$

The date of joining the company is not reported for a significant number of executives in Execucomp (3,758 distinct executives amounting to 19,632 observations). To increase our coverage we hand-collected this information using mainly the information aggregator NNDB.com. If the date was not available at NNDB, then we checked in LinkedIn, Bloomberg, and investor relations web pages. If dates were still not available, we searched on SEC filings and relevant articles in the business press.

Forced turnover data. Data on forced CEO turnover was graciously shared by Florian Peters. He and a team of researchers gathered these data for CEOs listed in Execucomp from years 1995 to 2015. The criteria used to classify turnover as forced are described in detail in Peters and Wagner (2014) and Jenter and Kanaan (2015). Both methodologies follow the three-step criteria to classify

[29] Six firms (86 observations) have nonclassifiable industries. We drop these from our estimation sample.

successions as forced from Parrino (1997):

1. "All successions for which the *Wall Street Journal* reports that the CEO is fired, forced from the position, or departs due to unspecified policy differences are classified as forced."
2. "All other successions in which the departing CEO is under age 60 are reviewed to identify cases in which the *Wall Street Journal* announcement of the succession either (1) does not report the reason for departure as involving death, poor health, or the acceptance of another position (elsewhere or within the firm), or (2) reports that the CEO is retiring, but does not announce the retirement at least six months before the succession. These cases are also classified as forced successions."
3. "The circumstances surrounding departures that are classified as forced in the previous step are further investigated by searching the business and trade press for relevant articles. These successions are reclassified as voluntary if the incumbent takes a comparable position elsewhere or departs for previously undisclosed personal or business reasons that are unrelated to the firm's activities."

If turnover is not classified as forced in Florian Peters' data, it is assumed to be voluntary. For a small number of cases, forced turnover is reported in year t, but the executive is still listed as CEO in year $t+1$. To avoid inconsistencies, all indicators of turnover are moved to the last year of the CEOs tenure as reported in Execucomp. In our final sample, we observe 590 instances of forced turnover and 1,577 instances of voluntary turnover.

Prior familial relation to the firm. We hand collected data on family ties within firms using Definitive Proxy Statements (DEF 14A) filed with the Security and Exchange Commission as our main source of information. For CEOs for which a family tie could not be verified via DEF 14A, we conducted Internet searches. We define a CEO as related if they have any direct family relations, by blood or marriage, to the founder, another board member, or a previous CEO, as indicated in the EDGAR database or elsewhere in Internet searches. Of the 4,521 executives in our final sample, 415 (9.2%) are classified as related CEOs.

Osiris data. To determine which firms are family-controlled, we use ownership data from the Osiris database, which surveys firms globally and identifies those in which a single entity owns at least 25 percent of outstanding equity. Examples of controlling entities are banks, governments, private equity firms, or other corporations. If Osiris states that a firm is controlled by "one or more named individuals or families," we classify them as "family-controlled."

After classifying Osiris firms as family-controlled or not, we merge these data with our main sample using stock ticker and company name. We first merge the main sample with Osiris by stock ticker. Because Osiris is a global database and firms are traded on different exchanges (for instance, if they are based in different countries), different firms in the data may share the same ticker. To overcome this, we use *matchit* in Stata to conduct a subsequent name comparison within each stock ticker. Within each stock ticker, we compare company names and only keep the highest quality match as determined by *matchit*'s simple similarity score function. This results in exactly one firm per stock ticker. Lastly, we hand check any observations with imperfect name matches. This last step results in 26 firms being dropped.

A.1.1 Firm Performance and CEO Tenure

TABLE A.1: IA-ROA Regression

	(OLS)		(FE)	
	Coefficient	SE	Coefficient	SE
Constant	-.961	(1.94)	-14.4	(16.0)
Performance Lag	.822***	(.011)	.452***	(.028)
Tenure	-.011	(.016)	-.497	(.310)
Tenure^2	$2.8e^{-4}$	($4.5e^{-4}$)	$-4.6e^{-4}$	(.002)
Age	.029	(.067)	.313	(.383)
Age^2	$-2.0e^{-4}$	($5.8e^{-4}$)	.001	(.002)
Observations	20,401		20,401	

Notes: The dependent variable in both columns is IA-ROA. Column (1) estimates the model by OLS while column (2) includes fixed effects for each CEO-firm match. *, **, and *** denote significance at the 10% level, 5% level, and 1% level respectively. Both columns suggest that the dependence of firm performance on CEO tenure is insignificant.

A.2 Model Appendix

A.2.1 CEO Age

To reduce the size of the state space, we discretize CEO age a_{jit} into 5 categories $\bar{a}_{jit}$ as follows:

$$\bar{a}_{jit} = \begin{cases} 1 & \text{if} \quad a_{jit} < 40 \\ 2 & \text{if} \quad a_{jit} \in [40,59] \\ 3 & \text{if} \quad a_{jit} \in [60,64] \\ 4 & \text{if} \quad a_{jit} \in [65,79] \\ 5 & \text{if} \quad a_{jit} \geq 80 \end{cases} \tag{A.1}$$

Upon being hired, each CEO j has an age category drawn from the empirical distribution of $\bar{a}_{ijt}$ conditional on turnover (denoted by F_a). The associated probability mass function is given in Table A.2.

TABLE A.2: Distribution of $\bar{a}_{jit}$ Conditional on Turnover

	Age Group				
	< 40	$[40,59]$	$[60,64]$	$[65,79]$	≥ 80
Probability	.0247	.8526	.0897	.0325	.0005

In our empirical specification $\bar{a}_{jit}$ evolves stochastically with the following transition probabilities computed from the data:

TABLE A.3: Empirical Age Transition Probabilities

Age Group	< 40	$[40,59]$	$[60,64]$	$[65,79]$	≥ 80
< 40	.7043	.2957	0	0	0
$[40,59]$	0	.9305	.0695	0	0
$[60,64]$	0	0	.8848	.1152	0
$[65,79]$	0	0	0	.9903	.0097
≥ 80	0	0	0	0	1

A.3 Estimation Appendix

For estimation we minimize a standard SMM objective function using the particle swarm algorithm. The process is summarized as follows:

1. *Estimate first-stage parameters:* We first estimate the parameters determining the process of voluntary turnover in equation (12) using a logit regression.

2. *Set initial guesses for second-stage parameters:* We set initial values for the second-stage parameters $\Theta = \{\mu_\theta, \sigma_\theta^2, \sigma_\eta^2, \sigma_{sI}^2, \sigma_{sR}^2, \rho, c, \pi_0, \pi_R, \pi_S, p_0, \Delta_p\}$. We manually choose an initial guess, but subsequent guesses are selected by the minimization algorithm mentioned above.

3. *Discretize state space and compute state transition matrix:* To initialize the economic environment, we construct a discrete grid for the continuous variables $\tilde{\theta}_{jit}$ and y_{it-1}. The grid consists of 20 equally-spaced points centered on the initial guess for μ_θ. Next, we compute a transition matrix to describe the evolution of beliefs over tenure. The probability of moving from $\tilde{\theta}_{jit}$ to $\tilde{\theta}_{jit+1}$ given other relevant state variables is:

$$\begin{aligned}
&\pi(\tilde{\theta}_{jit}, \tilde{\theta}_{jit+1} | m_{jit}, \tau_{jit}, y_{it}) = \Phi(y_u | m_{jit}, \tau_{jit}, y_{it}) - \Phi(y_l | m_{jit}, \tau_{jit}, y_{it}) \\
&= \Phi\left((1-\rho) y_{it} + \frac{\rho}{\tilde{\sigma}^2(\tau_{jit})} \left((\tilde{\theta}_{jit+1} + \phi/2)(\tilde{\sigma}^2(\tau_{jit}) + \sigma_\eta^2) - \tilde{\theta}_{jit}\sigma_\eta^2 \right) | m_{jit}, \tau_{jit}, y_{it} \right) \\
&\quad - \Phi\left((1-\rho) y_{it} + \frac{\rho}{\tilde{\sigma}^2(\tau_{jit})} \left((\tilde{\theta}_{jit+1} - \phi/2)(\tilde{\sigma}^2(\tau_{jit}) + \sigma_\eta^2) - \tilde{\theta}_{jit}\sigma_\eta^2 \right) | m_{jit}, \tau_{jit}, y_{it} \right) \qquad \text{(A.2)}
\end{aligned}$$

   where m_{ijt} is the current CEO's managerial type, τ_{jit} is the CEO's tenure, and y_{it} is firm performance in period t. ϕ denotes the space between points in the profitability grid.

4. *Solve the value functions:* Next, we solve for V_0 and V_1 by iterating the corresponding Bellman equations. V_0 is the value of retaining a CEO while V_1 is the value associated with turnover. Each of the value functions is dependent on the state variables $x_{it} = \{\tilde{\theta}_{jit}, \tilde{\sigma}_{jit}, m_{jit}, y_{it-1}, a_{jit}, \varphi_i\}$. We start with an initial guess for each of the value functions, then iterate until we approximate the fixed point as determined by convergence criteria $\|T_k(V_k) - V_k\| < .1$ where T_k for $k \in \{0, 1\}$ are contraction mappings whose fixed points are V_0 and V_1, respectively.

5. *Simulate initial conditions:* To correct for bias induced by left-censoring of our data, we first simulate decision-making until the simulated distribution of tenure matches the empirical distribution in the first year of the sample. Specific details on this procedure are discussed in Appendix A.3.1. For this step we simulate data for 20,000 firms. Firms' hiring and firing decisions are based on the value functions obtained in the previous step.

6. *Construct firm panel and compute simulated moments:* Following this simulation of initial conditions, we simulate the model for 20 additional years and construct a panel of the 20,000 simulated firms and their optimal decisions. We use this panel to compute simulated moments using the exact same code employed to compute the empirical moments, which helps avoid inconsistencies during estimation. Next we evaluate the SMM objective function below:

$$\hat{\Theta} = argmin_\Theta \; (\hat{M} - \frac{1}{S}\sum_{s=1}^{S} \hat{m}^s(\Theta))' \; W \; (\hat{M} - \frac{1}{S}\sum_{s=1}^{S} \hat{m}^s(\Theta)) \qquad \text{(A.3)}$$

where $\hat{M}$ denotes the vector of empirical moments and $\hat{m}^s(\Theta)$ denotes the vector of simulated moments in simulation s given parameter vector Θ. We simulate the model $S = 20$ times on each iteration of the estimation algorithm. The algorithm is terminated when the relative change in the SMM objective function value over the preceding 20 iterations is less than or equal to 1e-6.

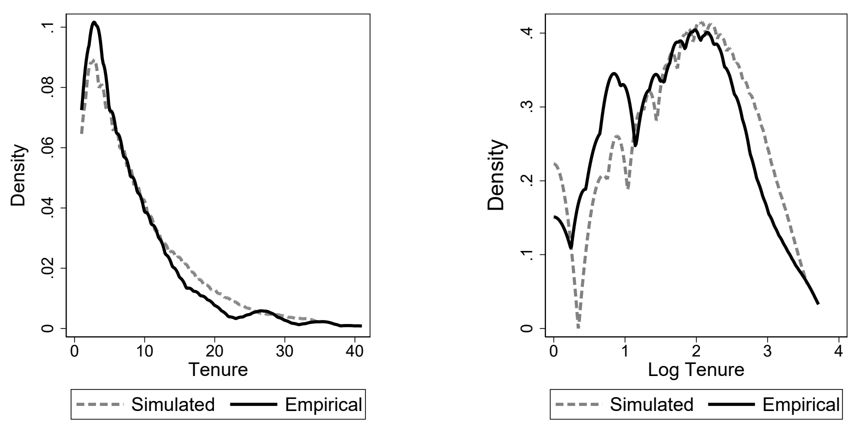
A.3.1 Initial Conditions

Since our data is left-censored, we control for the data's initial conditions by first simulating the model until we match the initial distribution of log tenure in the data, for every iteration of the estimation algorithm. Concretely, we match the first two moments of the 1996 distribution of log tenure given by:

TABLE A.4: Moments of Initial Tenure Distribution

	Mean ($\mu_{\tau,96}$)	Variance ($\sigma^2_{\tau,96}$)
$log(tenure_{1996})$	1.74	.780

Define $\gamma_{96} \equiv [\mu_{\tau,96}, \sigma^2_{\tau,96}]$ and define $\hat{\gamma}(t) \equiv [\hat{\mu}_{\tau,t}, \hat{\sigma}^2_{\tau,t}]$ as the vector containing the moments of the simulated tenure distribution in simulation period t. We begin the simulation in $t = 1$, where each firm hires an initial CEO and the tenure distribution is a single mass point at 1, and let it run until the Euclidian distance between γ_{96} and $\hat{\gamma}(t)$ approaches zero. After 40 years the tenure distribution is fairly stable. We choose to simulate the model for 50 periods and begin collecting simulated data in period 51. Figure A.1 compares the simulated tenure distribution after 50 years of decision making with the initial empirical tenure distribution at 1996:



(a) Tenure (b) Log Tenure

FIGURE A.1: Fit of Initial Tenure Distribution

A.3.2 Moments

We use a vector of 26 moments in the data to estimate the second-stage parameters in Table A.5. In this section we briefly discuss the relationship between moments and model parameters.

TABLE A.5: Model Parameters

Notation	Definition
μ_θ	Mean of population distribution of match quality among CEO candidates
σ_θ^2	Variance of population distribution of match quality among CEO candidates
σ_η^2	Variance of idiosyncratic shocks to profitability
σ_{sI}^2	Variance of insider candidate signals
σ_{sR}^2	Variance of related candidate signals
ρ	Persistence in firm profitability
c	Monetary cost of turnover (forced or voluntary)
π_0	Baseline entrenchment: non-pecuniary cost from firing a CEO
π_R	Related entrenchment: added non-pecuniary cost from firing a related CEO
π_S	Preference for related-to-related transitions
p_0	Probability of a related candidate being available at a non-family-controlled firm
Δ_p	Aditional probability of a related candidate being available for family-controlled firms

The first set of moments are coefficients of the pooled regression:

$$y_{jit} = \lambda_0 + \lambda_1 y_{jit-1} + \lambda_2 \, internal_{jit} + \lambda_3 \, related_{jit} + \Delta^{(-1)} + \Delta^{(0)} + \Delta^{(1)} + \delta_{jit} \tag{A.4}$$

We regress industry-adjusted ROA y_{jit} on its lag y_{it-1}, an indicator $internal_{jit} = 1$ if CEO j at firm i at time t is an insider or related CEO, an indicator $related_{jit} = 1$ if the CEO is related, and indicators $\Delta^{(k)} = 1$ if forced turnover occurred k years ago.[30] The intercept term λ_0 carries information about the mean of the population distribution of CEO match quality μ_θ, while the persistence term λ_1 contains information regarding ρ. The internal coefficient λ_2 carries information about σ_{sI}^2, while the related coefficient λ_3 carries information about the difference between σ_{sI}^2 and σ_{sR}^2. Firms value CEOs for two reasons: estimated ability today, and option value in the future. The option value arises here because the firm has the option to fire the CEO in the future if performance is sufficiently poor. This firing option allows firms to largely escape the downside risk, while fully enjoying the upside risk. Hence, CEOs for whom the board has a high prior variance carry high information value. Because the prior variance is higher for outsiders than insiders, outsiders carry higher information value. For this reason, insider and related CEOs must have strictly higher estimated match qualities in order to overcome the information value gap and be selected over

[30] We omit j in the lag profitability y_{it-1} as the CEO in $t-1$ might be different from j.

outsiders. The parameters σ_{sI}^2 and σ_{sR}^2 determine the difference in option value between outsiders and internal candidates, impacting the difference in average match qualities between internal and external candidates at time of hire. Hence, the auxiliary parameters λ_2 and λ_3 carry information about the signal variances σ_{sI}^2 and σ_{sR}^2. The terms Δ^k are most informative about the monetary cost of turnover c.

Let τ_{ji}^* denote the spell length of CEO j with firm i. Define

$$\varepsilon_{ji\tau} \equiv y_{ji\tau} - \hat{\upsilon} y_{ji\tau-1} \tag{A.5}$$

$$\hat{\theta}_{ji} \equiv \frac{1}{\tau_{ji}^*} \sum_{\tau=1}^{\tau_{ji}^*} \varepsilon_{ji\tau} \tag{A.6}$$

where $\hat{\upsilon}$ is the estimated persistence parameter from the AR(1) process for IA-ROA as in Equation (2). Variable $\hat{\theta}_{ji}$ is the within-spell average of residual performance for the CEO-firm pair ji. Moment (A.7) below is informative of the variance of performance shocks σ_θ^2, while (A.8) helps pin down the variance of the population CEO match quality distribution σ_η^2:

$$Var(\hat{\theta}_{ji}) \tag{A.7}$$

$$\mathbb{E}\left[Var_{ji}(\varepsilon_{ji\tau})\right] \tag{A.8}$$

$Var_{ji}(\varepsilon_{ji\tau})$ is the within-spell variance of residual performance for spell ji and the expectations operator denotes the average of the variance of residual performance across all CEO spells.

The next set of moments come from the following hazard regression:

$$d_{jit} = f^{(1-2)} + f^{(3-4)} + f^{(5-7)} + f^{(8+)} + \sum_k f^k * internal_{jit} + \sum_k f^k * related_{jit} + \xi_{jit} \tag{A.9}$$

The indicator d_{jit} equals one in the case of forced turnover. The terms $f^{(k)}$ are the estimated probability of forced turnover occurring at tenure k. We include interaction terms to capture differences in turnover patterns among the different classes of CEOs. The hazards are informative about the non-pecuniary firing cost π_0, while the interaction terms $f^k * internal_{jit}$ are informative about σ_s^2. The more uncertainty over CEO quality there is at the time of hire, the higher the likelihood of forced turnover. Hence, differences in firing rates across CEO types is indicative of different levels of uncertainty. Additionally, the assumption that π_0 is only incurred following forced turnover while c is incurred following both forced and voluntary turnover helps to separately identify the two. The interaction terms $f^k * related_{jit}$ capture the difference in firing rates between insider and related CEOs, and thus are informative of the related-CEO firing cost π_R.

Lastly, we match the insider and related hiring probabilities separately. We compute these statistics separately for family-controlled ($\phi_i = 1$) and non-family-controlled firms ($\phi_i = 0$). Let h^I_{it} and h^R_{it} be indicators equal to one if firm i employs an insider or related CEO, respectively. We match the following four moments:

$$\begin{aligned} &\mathbb{E}[h^I_{it} \,|\, \phi_i = 1] \quad \mathbb{E}[h^R_{it} \,|\, \phi_i = 1] \\ &\mathbb{E}[h^I_{it} \,|\, \phi_i = 0] \quad \mathbb{E}[h^R_{it} \,|\, \phi_i = 0] \end{aligned} \tag{A.10}$$

The difference in probabilities of related hires for FC and NFC firms helps to identify the related supply parameter p_R. For information about the preference parameter π_S, we match the probability of hiring a related CEO conditional on the previous CEO being related. Given that π_S holds the same value whether a firm is FC or NFC, we pool FC and NFC firms when computing this final moment.

A.3.3 Standard Errors

Similar to Gayle and Miller (2009), we follow Theorem 6.1 in Newey and McFadden (1994) to obtain corrected standard errors for our second-stage estimates. The correction is based on the one-stage asymptotic distribution of Θ (Duffie and Singleton, 1993). Let θ_1 denote the parameters of the first stage (Table A.9) and let $g_0(\theta_1)$ be the score function of the first-stage likelihood. Define $g(\Theta, \theta_1)$ as:

$$g(\Theta, \theta_1) = \hat{M} - \frac{1}{S}\sum_{s=1}^{S} \hat{m}^s(\Theta, \theta_1) \tag{A.11}$$

with $\hat{M}$, $\hat{m}^s(\Theta, \theta_1)$, and S as defined in equation (A.3). Define:

$$G_\Theta = E\left[\nabla_\Theta g(\Theta, \theta_1)\right] \tag{A.12}$$

$$G_{\theta_1} = E\left[\nabla_{\theta_1} g(\Theta, \theta_1)\right] \tag{A.13}$$

$$g(z) = g(\Theta, \theta_1) \tag{A.14}$$

$$M = E\left[\nabla_{\theta_1} g_0(\theta_1)\right] \tag{A.15}$$

$$\psi(z) = -M^{-1} g_0(\theta_1) \tag{A.16}$$

Then under standard regularity conditions

$$\sqrt{n}(\hat{\Theta} - \Theta) \to^d N(0, V_\Theta) \tag{A.17}$$

where

$$V_\Theta = \left(1+\frac{1}{S}\right)(G'_\Theta W G_\Theta)^{-1} E[\{G'_\Theta W g(z) + G'_\Theta W G_{\theta_1} \psi(z)\}\{G'_\Theta W g(z) + G'_\Theta W G_{\theta_1} \psi(z)\}'](G'_\Theta W G_\Theta)^{-1} \tag{A.18}$$

And W is the optimal weighting matrix given by the inverse of the covariance matrix of the vector of estimation moments. For each moment m and parameter p we approximate the Jacobian using:

$$\frac{\partial \hat{g}_m(\Theta)}{\partial \Theta_p} = \frac{g_p(\hat{\Theta}+h_p) - g_p(\hat{\Theta})}{h_p} \tag{A.19}$$

where h_p is the perturbation size for parameter p which we set to 1% of the absolute value of the parameter estimate.

A.3.4 Additional Details on Model Fit

TABLE A.6: ROA Regression Fit

$y_{jit} = \lambda_0 + \lambda_1 y_{jit-1} + \lambda_2 internal_{jit} + \lambda_3 related_{jit} + \Delta^{(-1)} + \Delta^{(0)} + \Delta^{(1)} + \delta_{jit}$

	Simulated Coefficient	Empirical Coefficient	SE	t-stat
Constant	.153	-.291	(.075)	-5.90***
y_{ijt-1}	.807	.816	(.010)	.847
$internal_{ijt}$	.132	.365	(.091)	2.56***
$related_{ijt}$	-.041	-.145	(.124)	-.839
$\Delta^{(-1)}$	-3.49	-1.38	(.405)	5.20***
$\Delta^{(0)}$	-4.08	-2.99	(.353)	3.10***
$\Delta^{(1)}$	-1.48	-.306	(.370)	3.18***

Notes: t-statistics are reported to measure fit. They are computed as the difference in the empirical moment from the simulated moment divided by the standard error of the empirical moment. *, **, and *** signify that the empirical and simulated moments are different at the 10%, 5% and 1% level, respectively.

TABLE A.7: Hazard Regression Fit

$d_{ijt} = h^{(1-2)} + h^{(3-4)} + h^{(5-7)} + h^{(8+)} + \sum_k h^k * insider_{ijt} + \sum_k h^k * family_{ijt} + \eta_{ijt}$

	Simulated Coefficient	Empirical Coefficient	SE	t-stat
$h^{(1-2)}$	.017	.019	(.003)	.799
$h^{(3-4)}$	.036	.039	(.005)	-.627
$h^{(5-7)}$	.030	.037	(.004)	1.69*
$h^{(8+)}$	.019	.021	(.002)	.821
$h^{(1-2)} \times insider_{ijt}$	-.006	-.007	(.004)	-.337
$h^{(3-4)} \times insider_{ijt}$	-.012	-.011	(.006)	.205
$h^{(5-7)} \times insider_{ijt}$	-.008	-.009	(.005)	-.229
$h^{(8+)} \times insider_{ijt}$	-.002	-.004	(.003)	-.523
$h^{(1-2)} \times family_{ijt}$	-.009	.002	(.008)	1.31
$h^{(3-4)} \times family_{ijt}$	-.018	-.024	(.005)	-1.21
$h^{(5-7)} \times family_{ijt}$	-.015	-.019	(.006)	-.750
$h^{(8+)} \times family_{ijt}$	-.006	-.010	(.003)	-1.07

Notes: t-statistics are reported to measure fit. They are computed as the difference in the empirical moment from the simulated moment divided by the standard error of the empirical moment. *, **, and *** signify that the empirical and simulated moments are different at the 10%, 5% and 1% level, respectively.

TABLE A.8: Hiring Probability Fit

	Simulated Coefficient	Empirical Coefficient	SE	t-stat
Related insider (FC)	.143	.130	(.038)	-.337
Unrelated insider (FC)	.484	.546	(.057)	1.08
Related insider (NFC)	.047	.040	(.005)	-1.36
Unrelated insider (NFC)	.528	.580	(.011)	4.62***
Related-to-Related transition	.126	.183	(.060)	.969

Notes: t-statistics are reported to measure fit. They are computed as the difference in the empirical moment from the simulated moment divided by the standard error of the empirical moment. *, **, and *** signify that the empirical and simulated moments are different at the 10%, 5% and 1% level, respectively.

A.4 Results Appendix

A.4.1 Voluntary Turnover

Table A.9 presents the estimates of our logistic model of voluntary turnover. We use the discrete age categories as described in Appendix A.2. The likelihood of voluntary turnover is increasing at a decreasing rate with respect to tenure, and monotonically increasing with respect to age. Related CEOs are significantly less likely to quit than outsider CEOs, while insider CEOs are slightly more likely to quit.

TABLE A.9: Voluntary Turnover Model

	Coefficient	SE	$\frac{\partial p}{\partial x}(\%)$	SE
Constant	-1.23***	(.327)		
$tenure_{ijt}$	.081***	(.013)	.889***	(.167)
$tenure^2_{ijt}$	-.002***	(.000)		
$\mathbf{1}\left[age_{ijt} < 40\right]$	-2.76***	(.494)	-29.5***	(6.94)
$\mathbf{1}\left[age_{ijt} \in [40,59]\right]$	-2.56***	(.313)	-28.9***	(6.85)
$\mathbf{1}\left[age_{ijt} \in [60,64]\right]$	-1.20***	(.311)	-19.9***	(6.81)
$\mathbf{1}\left[age_{ijt} \in [65,79]\right]$	-.754**	(.312)	-14.0***	(6.80)
$\mathbf{1}\left[\ related_{ijt} = 1\ \right]$	-.589***	(.104)	-11.0***	(2.47)
$\mathbf{1}\left[\ insider_{ijt} = 1\ \right]$	.108*	(.059)	2.36*	(1.29)
Observations		24,775		

Notes: Results from a logistic regression of voluntary turnover on tenure, age, and CEO type. *SE* are the standard errors; *, **, and *** denote significance at the 10% level, 5% level, and 1% level, respectively. Column $\frac{\partial p}{\partial x}(\%)$ indicates the marginal effect in percentage points.

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