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Board Characteristics & Peer Peformance In CEO Turnover Decisions

The Effect of Board Characteristics On The Impact Of Peer-Induced Returns In Cases Of Forced CEO Turnover

Saad Bin Anis and Sindre Larsen

Supervisor: Assosiate Professor Konrad Raff

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Preface

This thesis is written as a part of our Master of Science degree at the Norwegian School of Economics (NHH). The purpose of this thesis is to investigate the impact of board characteristics on the observed tendency of boards to consider industry or peer-induced performance when evaluating the CEO's performance and deciding to fire or retain the CEO.

Our initial data sample as required extensive work with multiple academic databases as well as programming in R to implement certain numerical calculations. Ina addition, Microsoft Excel has been used to structure and sort the data. We used the statistical software STATA for our empirical analysis.

This thesis has been a great learning opportunity for us. Through it, we have gained a better grasp of econometrics and the steps in the academic research process. We have also gained a deeper understanding of several topics in corporate governance, particularly those which relate to board of directors and CEO turnover.

We would like to express our sincere gratitude to our supervisor, Associate Professor Konrad Raff. Throughout this thesis, he has provided us with invaluable feedback, ideas and guidance. Without his support and input, this would be a much inferior thesis.

We would also express our thanks to our friends and family, for all the support and help they have provided during this thesis.

Bergen 2018,
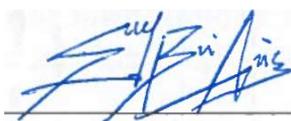
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Abstract

We show that certain characteristics of the board of directors make it more prone to consider industry or peer-induced returns when making decisions to fire or retain the CEO. The board may hold the CEO responsible for exogenous, industry-related factors when evaluating CEO performance. We show that higher percentage of independent directors, smaller board sizes and, to a lesser extent, lower duration of the board, can reduce the sensitivity of forced CEO turnover probability to peer-induced returns. This may make it less probable that the board punishes or rewards a CEO for factors outside her control. We quantify the change in turnover probability due to changes in the above-mentioned board characteristics and show that the change in probability is greater for firms with poor returns than for firms with higher returns. Our contribution to the exiting literature is to show that the sensitivity of forced CEO turnover to peer-induced performance is affected by certain board characteristics, and its impact is more pronounced for firms with low returns.

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Section 1: Introduction & Overview

One of the key roles of the board of directors in any firm is to evaluate the performance of the CEO and to fire CEOs who have not delivered, or are believed to be incapable of delivering, the desired level of firm performance. However, firm performance is dependent not only on the skill and ability of its management, but also on exogenous factors outside the control of top management. The CEO of Statoil may be extremely capable, but if oil prices touch $20 per barrel, there is little he can do to improve the bottom line. Therefore, a relevant question is how good are boards at being able to evaluate the performance of the CEO, and to separate performance due to industry-induced factors and performance due to CEO ability?

We should point out that there can be very good reasons for the link between industry-induced factors and CEO turnover. Firing the CEO due to low industry turnover may occur as a bid to help to reduce competition in oligopolistic industries, as punishment for suboptimal CEO decisions or due to the low industry returns showing that the CEO lacks required skills (Jenter & Kanaan, 2015). In a competitive assignment framework, low industry returns may reveal that the CEO and firm are not a good match, which would prompt the board to terminate the CEO (Eisfeld & Kuhnen, 2013).

Another reason could be the inability of the board to effectively separate performance due to industry and performance due to the CEO's own efforts. We do not claim that a link between industry-induced returns and CEO turnover is *always* a bad sign, simply that such a link means that industry performance was, for whatever reason, (mis)attributed to the CEO. Ideally, the CEO should be punished only for the performance due to her own efforts.

There are two main findings of our analysis. First, we show boards do not completely filter out industry-induced factors when evaluating CEO performance. As a result, the board may fire a CEO for poor performance of the firm even if it was due to factors outside the CEO's control. This result implies that the CEO may be punished for low stock returns even if it is caused by poor industry performance. Alternatively, the CEO may be able to hide behind good industry performance, even though the CEO may have performed poorly herself. Of course, there may be other reasons for this link, as we highlighted earlier.

Secondly, we show that the tendency of the board to attribute industry-induced performance to the CEO (hereafter called misattribution) is dependent on the characteristics of the board. Certain board characteristics are statistically significant in predicting misattribution. Therefore, firms may be able to improve the quality of their turnover decisions by changing these

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characteristics; namely, increasing the percentage of independent directors, using smaller-sized boards and reducing board duration (the number of years after which directors are up for re-election). In addition, we quantify the effect of changing board characteristics on the quality of CEO turnover decision.

The main contribution of our research is to explicitly model the link between misattribution by the board and board characteristics, and to show that certain board characteristics may help reduce misattribution and improve turnover decisions. This research also contributes to the literature on CEO turnover, by showing how the CEO turnover sensitivity to industry performance is affected by board characteristics. It indicates that some boards may be more prone to consider industry or peer returns when evaluating the CEO and making turnover decisions.

Our analysis uses data collected from CRSP, Compustat and Datastream. We create a sample of firms across multiple industries over the period 2005 to 2016 and collect data on stock returns, accounting variables, governance data and CEO turnover.

The Fama-French industry grouping (Fama & French, 1997) - henceforth Fama-French- groups firms into industries based on the firm's Standard Industry Classification (SIC) codes. The Hoberg-Philips peer groups (Hoberg & Phillips, 2018) - henceforth Hoberg -Phillips - are based on similarity of products and business lines. We use both the Fama-French and Hoberg-Philips peer grouping methodologies to create peer groups for each firm in our sample. These returns are used as proxies for industry-induced performance i.e. part of firm performance that is outside of CEO control.

We calculate both value-weighted and equally-weighted peer returns for each of the above-mentioned peer grouping methodologies, and split total firm return into 2 parts: peer-induced return (caused by industry or peer returns), and idiosyncratic returns (correlated to CEO effort). We show that peer-induced returns are negatively related to CEO turnover probability. Had the board filtered out industry-induced factors when evaluating the CEO, there would be no relation between industry-induced returns and CEO turnover. However, the results show that lower industry-induced returns increase the probability of the CEO being fired, implying that the board is attributing return due to peer-induced factors to the CEO (misattribution).

We calculate the values of misattribution predicted by the above method for our sample (henceforth, *predicted misattribution*). We model the predicted misattribution as a function of various board characteristics, controlling for firm size. Using this model, we show how the

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different board characteristics effect the predicted misattribution. Subsequently, we change board characteristic values e.g. percentage of independent directors and find the new predicted misattribution (termed *implied misattribution*). The difference between predicted and implied misattribution is that the former is the predicted value of misattribution if the board characteristics are unchanged from sample values. In the case of the latter, we change the board characteristics by a fixed amount for all firms, and then find the predicted value. The purpose is to see the effect of changing the board characteristic on predicted misattribution.

A key issue in such research is establishing causality between CEO turnover and the board. Research indicates that board characteristics are influenced by CEO turnover, and vice versa (Hermalin & Weisbach, 1988). Our approach attempts to not fall prey to this issue. We start by regressing peer returns on firm returns. Reverse causality is unlikely here as it is unlikely that a single firm's results could cause change in the returns of its entire peer group. It may be that in industries that are dominated by one large firm, the return of that firm may have a strong influence on the returns of the whole industry. However, our sample has only a few industries where a single firm dwarfs the rest. We then regress peer-induced and idiosyncratic returns on CEO turnover probability using a Probit model. Here, reverse causality is unlikely. Reverse causality may exist between board characteristics and CEO turnover but is unlikely to exist between lagged peer returns of a firm (which is what the misattribution is in our model).

It can be hypothesized that the effect of changing board characteristics on misattribution may depend on firm performance. For example, increasing the percentage of independent directors may have a greater effect on misattribution if the firm is a high performing firm. To see if this the case, we compare the values of implied misattribution for firms in the top and bottom quartile by firm performance and find that there is no difference. The effect of changing board characteristics on misattribution is independent of firm performance. One may postulate that the effect of changing board characteristics may be affected by existing values of the board characteristic. For example, increasing the percentage of independent directors may have a lower effect on misattribution if the firm already has a high percentage of independent directors. We create top and bottom quartile of firms for each board characteristic and compare the implied misattribution in the quartiles. We find that there is no difference in implied misattribution i.e. the effect of changing board characteristics on misattribution appears to have a constant return scale.

Our findings are robust to different industry return calculations and controlled for factors such as CEO power and entrenchment, as well as firm size.

Research on CEO turnover is highly sensitive to the method used to classify turnovers as forced or voluntary. We need to separate forced turnovers (firings) from voluntary turnovers (due new job, personal reasons, retirement etc.). A number of different methods have been used in prior literature. These range from sophisticated text-analysis based methods (Parrino, 1997), to simpler age-based criteria, as well as methods based on analysis of firm performance.

Our turnover classification method is similar to the performance induced turnover methodology (Jenter & Lewellen 2017). We classify a turnover as forced if the firm underperformed its peer group in the period prior to the turnover. The reasoning is that if the firm underperformed, then it is more likely that the turnover was forced, regardless of the age of the CEO or the firm's press release. On the other hand, if the CEO had strong results in the prior period, then it is more likely that the turnover is voluntary since it would not be logical for the board to force out a high performing CEO. Of course, CEO firings may be due to factors other than prior period relative performance e.g. criminal behavior discovered in the current period may lead to the CEO's termination, regardless of prior performance. In addition, a CEO set to voluntarily retire next period may deliver inferior performance due to age or lack of motivation.

However, our classification system is robust to different criteria and checks. Consequently, our turnover criterion is classifying most of the turnovers correctly. Furthermore, we check the results using an age-based classification and see that this method is heavily dependent on subjective criteria. Changing a few subjective assumptions (for example, CEO retirement age) can completely change the results of the analysis.

A key issue in our research is data availability. Turnover and governance data for firms is more available for larger, well-established firms than for smaller firms. As a result, our data is skewed towards firms with large market capitalizations and our results cannot be assumed to hold for firms of all sizes. For example, our sample is restricted to firms with market capitalization between $11 billion and $18 billion. Firms outside of this range may not follow our findings.

In addition, due to data availability, many firms can have peer groups that are not representative of their actual industry. We document few cases where the peer group of a firm is only one or two other firms, even though the firm may face competition from many other firms that we do not have data for. This may lead to distorted results for that industry. This issue is rare in our

sample, so it does not change our results. Therefore, care should be taken when generalizing the results for all industries.

The rest of our thesis is structured as follows. Section 2 gives an overview of the existing literature on CEO turnover and board or directors. In Section 3 and 4, we will explain in detail our empirical methodology and our hypothesis along with the interpretations of coefficients. In Section 5, we present our empirical results and discuss the interpretations we get compared to the results we expected based on prior literature. Section 6 focuses on various econometric pitfalls common to such research, and how we control for these issues. We will focus on the issue of reverse causality using our methodology, as well as discussing an alternative technique used in prior literature and its suitability to our research. Finally, in Section 7, we present a summary of our sample and variables. The Appendix gives details on variable construction and the turnover classification methodology used.

Section 2: Review of Current Literature

In this section, we present a summary of the relevant prior literature. It must be noted that, since corporate governance and CEO turnover are vast research areas, we will limit ourselves to research most relevant to our thesis.

We start with discussing the literature regarding CEO turnover. Research supports evaluation of management (and other agents) on basis of relative performance in cases where all the entities or agents are exposed to common exogenous shocks (Hölmstrom, 1979; Diamond & Verrecchia,1982). Firm stock returns and market adjusted stock returns are good predictors of management changes, with low returns being directly correlated with CEO and management turnover (B.Warner, L.Watts, & H.Wruck, 1988). Such research indicates that management is evaluated relative to risk or market adjusted stock returns. Therefore, the question arises that how fully does the board separate returns due to industry or peers, and returns due to the management's own skill?

There is literature supporting the view that board does completely filter out exogenous and peer or industry induced factors during relative performance evaluations when making turnover decisions. Analysis of turnovers from 1980 to 1985 reveal that top management teams are equally likely to be changed or removed, regardless of industry health or performance (Morck, Shleifer, & Vishny, 1989). Research done on a sample of turnovers for CEOs in the banking industry supports the view that boards completely filter exogenous factors in making turnover decisions (Barro & Barro, 1990). A study of CEO successions from 1974 to 1986 also support these findings (Gibbons & Murphy, 1990). It is also shown that CEOs are often fired for poor returns due to reasons outside their control because of the boards tendency to not to fully filter out industry or peer related factors effecting performance (Jenter & Kanaan, 2015). In short, it appears that CEOs may be punished for factors beyond their control.

There seems to be a difference of opinion about whether boards filter out exogenous factors when firing CEOs or not. Some literature suggests that boards do filter out such factors. However, other research seems to show the opposite (Jenter & Kanaan, 2015). There are many reasons that suggest that boards and governance mechanisms may be unduly influenced by outside factors. Structural flaws in governance mechanisms are shown to exist and cause distortions in executive pay, with the board not contracting properly with CEOs when setting compensation (Bebchuk & Fried, Pay Without Performance: The Unfulfilled Promise of Executive Compensation, 2004). Additionally, boards are under increasing pressure from

shareholders to act when the company underperforms, causing directors to fire CEOs even if the low returns are not the CEO's fault (Fisman, Khurana, & Rhodes-Kropf, 2014).

An alternate explanation is that the low industry performance reveals additional information about the CEO to the board, which then influences the firing decision (Jenter & Kanaan, 2015). Recessions and low industry return may show to the existence of problems regarding firm-CEO match in terms of skills. In this case, a CEO may be let go because she no longer possesses the skills or characteristics required by the firm, due to changes in industry or technology. In such a case, turnover due to relative performance and peer comparison is not a case of boards not filtering out exogenous factors. Rather, it is a sign that the CEO and firm are no longer a match in terms of skills or other required characteristics (Eisfeld &.Kuhnen, 2013). Similarly, it is shown that industries with higher volatility have CEOs with higher chances of being dismissed and as such demand higher compensation. The finding rejects an entrenchment model where powerful CEOs have lower chances of being fired (Peters & Wagner, 2014). This supports the view that CEOs are fired due to firm-CEO mismatch, since CEO entrenchment is not a factor and even entrenched CEOs are fired due to reasons of firm-CEO mismatch, which is more likely in volatile industries. As mentioned previously, a link between industry-induced returns and turnover does not automatically mean the board did not properly filter the firm's performance.

A key issue is how CEO turnovers are classified as forced or voluntary in research. Traditionally, research has used classification algorithms based on text-analysis of news and/or CEO characteristics like age and tenure to decide if a turnover is forced or voluntary (Parrino ,1997). However, these methods do not consider firm performance when classifying turnovers. This may result in cases where some forced turnovers get misclassified as voluntary because the CEO is old, as only factors like CEO age or tenure are considered by the classification algorithm. The result is that many turnovers classified as voluntary (and so excluded from analysis) are forced turnovers (Kaplan & Minton, 2012). It is shown that many "voluntary" turnovers are forced turnovers. Focusing on how CEO turnover probabilities change with performance shows us such turnovers, termed "performance induced turnovers". This also means that prior literature may have been underestimating forced turnovers due to the nature of the classification algorithms used (Jenter & Lewellen, September 2017).

As can be seen from the above discussion, there seems to be some disagreement on if boards filter out exogenous factors when evaluating management performance and why this happens.

We see that, while there is a large body of work on CEO turnover, much of this research focus how probabilities of CEO turnover for a given performance level are affected by different board characteristics or other factors. There is less research focusing on how well the board can accurately assess management performance when making decisions about CEO turnover. The aim of our thesis is to contribute to this aspect of CEO turnover research.

We now discuss the literature on board characteristics. There is a large body of research on how the composition and characteristics of board of directors' effects different aspects of firm performance and behavior.

A board characteristic subject to extensive study has been the role and importance of independent directors in the board. Firms with boards dominated with independent or outside directors are shown to have stronger correlations between prior firm performance and CEO turnover compared to firms with majority of inside or dependent directors (Weisbach, 1988). This shows that independent directors enhance the monitoring of the CEO and are more willing to replace management that is not performing up to the mark.

However, there is evidence that firms hire independent directors who are sympathetic to management e.g. sell side analysts with optimistic views on firms, and such firms often have management sitting on the board and overall poor governance mechanisms (Cohen, Frazzini, & Malloy, 2012). This would cast doubt on the improvements in governance and monitoring that increasing number of independent directors are supposed to bring. However, it is worth noting that markets and investors appear to attach a high value to independent directors, and markets react negatively to the sudden death of independent directors (Nguyena & Nielsen, 2010).

A key issue in researching effects of independent directors is reverse causality. Research indicates that as CEOs near retirement, firms increase the number of dependent directors on the board in the hope of finding a successor. After a new CEO is appointed, many newly appointed dependent directors leave as they were perhaps hoping to get the job. Outside directors are more likely to join the firm if it performs poorly (Hermalin & Weisbach, 1988). It is therefore difficult to establish causality between the independent directors and CEO turnover. It is hard to decide if CEO turnover lead to more independent directors, or vice versa.

It can be argued that independent directors do not add to the governance of the firm as it may not be the increase in independent directors that lead to higher CEO turnover. Rather, increasing CEO turnover or inferior performance forces the firm to hire more independent

directors. However, quasi-natural experiments have been done. These experiments were created from changes in regulatory requirements on firms to have a minimum number of independent directors on their board. This situation removed the problem of reverse causality. The firms with less than legally required number of independent directors were forced by law to increase the percentage of independent directors on the board. It was shown that this significantly increased their CEO turnover sensitivity to performance (Masulis & Guo, 2015). This would indicate that it is indeed true that independent directors add to higher CEO monitoring and turnover.

The overall view seems to be that independent directors are important for the board to monitor CEO performance. Higher percentages of independent directors make boards more willing to remove CEOs who underperform. For our research, this view is important since it implies that independent directors are likely to affect the board's assessment of management performance.

The literature identifies board size as an important factor effecting board performance. Larger boards may cause poor governance due to problems of group think and directors not involving themselves fully into their work and hiding behind the work of others. Research appears to support this view, with larger boards being negatively correlated with firm profitability (Eisenberg, Sundgren, & Wells, 1998). Similarly, smaller boards have been shown to be more effective monitors as companies with smaller boards shown to have higher valuations, better financial ratios and stronger incentives for their CEOs (Yermack, 1996). On the other hand, firms with larger boards appear to have less variability in their performance and financial results, perhaps caused by larger boards needing to compromise more of different decisions thereby leading to decisions that are less extreme or one-sided (Cheng, 2008). Research in group decision making appears to support this view, with larger groups making more compromises and therefore making less extreme decisions than smaller groups (Sah & Stiglitz, 1986). Therefore, we conclude that board size is likely to matter in major decisions like CEO turnover and it could also affect its decision quality and ability to filter out exogenous factors in evaluating firm performance.

A related issue is the pressure faced by boards in making decisions. There is a large amount of literature which seeks to measure the effect of shareholder pressure on board and firm performance. It is conceivable that boards facing enormous amounts of pressure from shareholders would make rash decisions. In such a case, boards which are insulated from shareholder pressure may make better decisions in terms of increasing long term shareholder

value (Fisman, Khurana, & Rhodes-Kropf, 2014). It is also shown that board insulation, measured by staggered boards, does not negatively impact firm performance and leads to better innovation and stakeholder management (Cremers, Litov, & Sepec, 2017). Furthermore, it is argued that higher insulation and reduced exposure to shareholder pressure could have led to better risk management in US banks prior to 2008-2009 (Bratton & Wachter, 2010). However, there is also research that tends to point in the opposite direction. Staggered boards have been studied under natural experiments and have been empirically shown to reduce firm value (Cohen & Wang, 2013). Therefore, while it appears that insulation from shareholder pressure is factor effecting board decisions, it is unclear on what its impact could be on board decisions in a turnover decision. We will use board duration to proxy how much shareholder pressure boards are exposed to. While it may be argued that other metrics of board insulation e.g. staggered boards, are better measures, there is much less data available on such metrics, and therefore we use board duration as a proxy.

A dimension of boards that is increasingly important is the gender ratio of men to women and minorities on the board. Women and minorities bring fresh and diverse views to the table, and as such, higher gender ratios should be leading to better board decisions and (by extension) firm performance. There is research indicating that increasing representation of women and minorities, while controlling for other factors, is positively associated with higher firm value (Carter, Simkins, & Simpson, 2003). Increasing representation of women on boards can lead to stricter monitoring of management. Firms with gender diverse boars and high number of female board members are shown to have higher attendance for board meetings and greater sensitivity of CEO turnover to stock performance (Adams & Ferreira, 2009). These views are bolstered by surveys showing gender-diverse boards tend to work together more cooperatively and are more effective than boards with less diversity (Adams & Ferreira, Gender Diversity in the Boardroom, 2004). We conclude that gender ratios in boards are a factor that need to be considered if we are to measure quality of board decisions regarding CEO turnover.

We now turn to the topic of management power in the firm. This is a factor that must be controlled for. A "powerful" CEO can more likely prevent boards from firing him or easily mislead or influence the boards perception of the results. There is large body of research focusing on management entrenchment and CEO power in corporate decisions. There are shown to be differences in firm performance if the CEO is also the founder of the firm, which may be due to such CEO having higher influence in their firms (Fahlenbrach, 2009). Stock return variability is also shown to be higher in firms with more powerful CEOs as they

dominate decision making processes (Adams, Almeida, & Ferreira, 2005). Additionally, findings indicate that powerful CEOs can rig their performance evaluation by inducing the board to give higher weights to those performance metrics that are relatively better than others (Morse, Nanda, & Seru, 2011).

A key problem is how to measure an intangible and ambiguous variable like CEO power and influence on the board. CEO Pay Slice (CPS) is shown to be a proxy for CEO power and importance, and research shows that higher values of CPS are consistent with agency problems and rent extraction by CEOs and is negatively associated with firm value (Bebchuk, Cremers, & Peyer, 2011). Another metric may be CEO ownership in the firm. On the one hand, higher levels of management ownership of the firm serve to align the interests of management and shareholders and so lead to better firm performance (Mehran, 1995). At the same time, higher ownership may allow management greater control on decision making. It appears that CEO ownership has a non-linear impact, with Tobin's Q initially increasing and then decreasing as CEO ownership increases (Griffith, 1999).

Another relevant factor related to CEO power is CEO tenure. Analysis of the relation between firm performance and CEO turnover shows that turnover due to poor performance depends on CEO tenure, with entrenchment decreasing as CEO tenure increases for founders and outside CEOs (Allgood & Farrell, 2000). Similarly, CEO turnover risk appears to increase with increasing tenure, and tenure appears to be inversely related to monitoring by the board (Brookman & D.Thistle, 2009).

Overall, the above literature makes us conclude that CEO powers and influence must be controlled for when analyzing the board's ability to correctly evaluate management performance. Having shown the relevant literature on these various topics, we will now aim to show our research questions and methodology.

Section 3: Empirical Methodology & Hypothesis Development

In this section, we present the hypotheses that we will test; as well as the empirical methodology we apply. For the sake of clarity, we will discuss our hypothesis and empirical strategy simultaneously. Furthermore, we will discuss the results we expect given the existing literature. Lastly, we will then present some econometric pitfalls and how we control for these issues. The methodology applied in Section 3.1 to 3.3 is based on Jenter *et.al.* (Jenter & Kanaan, 2015). The later sections the methodology applied is our own.

3.1 Defining Misattribution in the Context of Our Research

As mentioned in Section 2, CEO turnover and board characteristics are both well-researched topics in corporate governance literature. However, most of the literature focuses on the sensitivity of CEO turnover to different board characteristics or other factors. The focus is on how CEO turnover is made more (or less) likely due to change in some factor. Therefore, most of the literature does not question whether the past CEO turnover was justified or free of any bias. Rather, it assumes that the historical decisions on CEO turnover are correct *a priori*.

The purpose of our research is to see if the decision to fire a CEO is indeed free of any sensitive to exogenous factors effecting firm performance. More specifically, our goal is to test if the board's decision to fire a CEO suffers from misattribution. We define misattribution as *"That part of probability of CEO turnover that is caused due to industry-induced performance, rather than the performance or skill of the CEO"*. After testing for the presence of misattribution, we will also test to see if there are certain board characteristics which may help reduce misattribution.

We divide our empirical strategy to test the above question in three parts present each part in order. Our research hypothesis will be presented in the relevant part.

3.2 Separating Industry-Induced Return & Idiosyncratic Return from Total Return

We separate total equity return of a firm for a given year (or firm-year) into two parts:

1. Return due to industry-induced performance i.e. the part of total return that is due to industry-induced factors, which will affect all the firms in the industry
2. Idiosyncratic return i.e. the part of return that is due to non-industry factors, including CEO talent and skill.

To separate industry-induced return from total stock returns, we create a peer group for each firm in the sample. A peer group for any firm A is the set of firms in the sample which can be

considered as competitors of - or similar to - firm A. Therefore, the return of the peers of firm A is a proxy for the return of the industry of firm A. It is important to note that we exclude the firm itself from its peers group.

We use two methods to classify peers for a firm: Fama-French industry grouping (Fama & French, 1997) and Hoberg-Phillips Text-based Network Industry Classifications (TNIC). It is important to clarify that these classifications refer to how to create peer groups for a firm. This should not be confused with how we classify turnovers as forced or voluntary. That method we explain in a later section.

Fama-French classifies firms into industry groups based on the firm's SIC codes, with all firms in one industry group assumed to be peers of each other. Hoberg-Philips uses text-analysis algorithms to compare how similar two firms are based on their products and business lines and considers similar firms to be peers. For each classification method, we calculate both market weighted, and equally weighted peer group returns.

Details regarding peer group classification methods and peer group return calculations can be found in the Appendix.

To separate peer-return from the idiosyncratic return, we regress the firm's peer returns on its total stock return, using the following model:

$$R_{i,t-1} = b_0 + b_1 R_{p,t-1} + \alpha_i + e_{i,t-1}$$

Here, $R_{i,t-1}$ is the total equity return of the firm for previous period, $R_{p,t-1}$ is the portfolio return of the peers of the firm in question for the previous period, $e_{i,t-1}$ is the corresponding error term and α_i is the firm specific fixed effect. We use a fixed effects model to control for any time invariant effects in peer groups. This is important as we are comparing different industry segments and there may be significant fixed effects over time due to factors such as regulatory changes, different industry dynamics etc.

This model divides each firm's total return for a year into two parts: a part driven by peer-induced return, and an idiosyncratic part that is not related to peer returns. The CEO turnover decision should not be affected by peer-induced return, as this part of total return is due to firm peers or other exogenous industry-related factors which are outside CEO control. However, the residual is the part of total return that is not due to the firm's peers. It is the idiosyncratic part of total return that is due factors other than peer or industry performance, such as CEO skill and effort.

We use the above model to find the predicted values of peer-induced returns, denoted $\hat{R}_{i,t-1}$, and the predicted residuals, denoted $\hat{e}_{i,t-1}$. These are defined as follows:

$$\hat{R}_{i,t-1} = \hat{b}_0 + \hat{b}_1 R_{p,t-1}$$

$$\hat{e}_{i,t-1} = R_{i,t-1} - \hat{R}_{i,t-1}$$

3.3 Identifying Misattribution: The Impact of Peer-Induced Returns & CEO Turnover

We now present and explain our first hypothesis:

H1: Decrease in peer-induced returns increases the probability of CEO turnover.

We postulate that boards are prone to misattribution. The board will punish the CEO for lower stock returns, even if the lower returns are due to peer-induced returns on which the CEO has no control, as the board may misattribute the lower peer-induced return to poor CEO skill.

We use the predicted values from section 3.2, and we check to see if they significantly predict forced CEO turnover:

$$p(TO_{i,t}) = \alpha_o + \alpha_1 \hat{R}_{i,t-1} + \alpha_2 \hat{e}_{i,t-1} + \alpha_3 Tenure_{i,t} + \alpha_4 Own_{i,t} + \alpha_5 Retire_{i,t} + \varepsilon_{i,t}$$

Here, $\hat{R}_{i,t-1}$ is the lagged predicted return for a firm from 3 the previous section, $\hat{e}_{i,t-1}$ is lagged predicted residuals for that firm, and $Tenure_{i,t}$ is CEO tenure in years in the current period. $Own_{i,t}$ is a dummy for if a CEO owns more than 5% of the firm's shares in the current period. $Retire_{i,t}$ is a dummy for a CEO is between 63 and 66 years of age. Appendix 1 gives detailed explanations of the construction of these variables.

It should be noted that while the CEO will be judged on prior period returns, the decision to fire him, and how her "power" effects the turnover probability is based on current period values. Therefore, we use current period values of tenure and ownership but lags of returns.

If there is no misattribution, then the board is expected to be able to filter out all the exogenous peer-induced return that is affecting stock performance because these are assumed to be outside the CEO's control. In this case, we would expect to see a failure to reject the hypothesis that $\alpha_1 = 0$ at a suitable level of significance. Only α_2 would be expected to be significantly different from 0. This is because the board will filter out any peer-induced returns from the evaluation of firm performance and so peer-induced returns will have no predictive power on whether the CEO is fired or not.

If misattribution does occur, it means that the CEO is being judged for factors beyond her control i.e. he may be fired for poor industry conditions that he did not have any control over. In such a case, we would expect both α_1 and α_2 to be significant and negatively related with turnover probability. The board will not only punish the CEO if returns are low due to her own lack of skill or effort (α_2), but also if the returns are low due to industry factors that the CEO does not have control over α_1.

3.4 Hypotheses Regarding the Link Between Board Characteristics and Misattribution

Having identified and isolated the misattribution, we now present our remaining hypothesis and why we expect them to be true.

H2: Higher board independence reduces misattribution

We expect to find a negative relationship between percentage of independent directors and predicted misattribution. We have seen that literature supports the view that increasing the percentage of independent directors in a board will make the board monitor a CEO more strictly and increase sensitivity of CEO turnover to firm performance (Masulis & Guo, 2015). We therefore expect a higher percentage of independent directors to be better able to monitor and evaluate the performance of the CEO and therefore will be less likely to misattribute performance.

H3: Higher percentage of women on the board reduces misattribution

Research indicates that higher representation of women and minorities on boards is correlated with higher firm value (Carter, Simkins, & Simpson, 2003), higher attendance at board meetings. The latter may lead to increased monitoring of the CEO by the board (Adams & Ferreira, 2009). More intense monitoring by the board will make it less likely to that the board will misattribute CEO performance. We therefore expect to find that an increase in percentage of female directors would decrease the predicted misattribution.

H4: Longer board durations reduces misattribution

The board duration, or the length of time before directors are up for re-election, is proxy for the insulation of the board from shareholder pressure. Based on prior literature showing that board insulation (based on staggered boards) leads to higher firm value (Fisman, Khurana, & Rhodes-Kropf, 2014) as well as better innovation and stakeholder management (Cremers, Litov, & Sepec, 2017), we hypothesize that increasing board duration will allow the board to

not be pressured by shareholders and reduce focus on short-term underperformance. Consequently, we expect higher board duration to be inversely related to misattribution.

H5: Larger board sizes increase misattribution

We expect that larger boards will lead to higher board misattribution, with δ_3 showing a significant and positive value. The existing research shows that larger boards tend to make more compromises and less extreme decisions, such as firing a CEO (Cheng, 2008). Additionally, we have seen that smaller firms are correlated with higher firm valuation (Yermack, 1996), indicating that smaller boards are more effective at delivering higher shareholder value. We believe that this indicates that smaller boards make better decisions, and as such, smaller boards are less likely to misattribute CEO performance.

3.5 Methodology to Test the Relation of Board Characteristics and Misattribution

We will now show our methodology to test for these hypotheses. We predict the value of misattribution for any given turnover (denoted as $\hat{m}$), where:

$$\hat{m}_{i,t} = \hat{\alpha}_1 \times \hat{R}_{i,t-1}$$

While the turnover itself happened in this period (denoted t), the misattribution is due to evaluation done on prior period returns (denoted $t-1$). Hence, the misattribution for the turnover today depends on the peer induced returns predicted for the last period. For any turnover, this is the predicted misattribution. We define predicted misattribution as *"the part of the normal distributed value for CEO turnover due to the board failing to properly filter out industry induced returns from the firm's total stock return"*.

We check to see if predicted misattribution is related to board features in the same period. The misattribution for this period (t) happened based on previous period peer induced returns ($t-1$) by a board sitting in the present period (t). Our model is therefore given as:

$$\hat{m}_{i,t} = \delta_0 + \delta_1 Gend\%_{i,t} + \delta_2 Indep\%_{i,t} + \delta_3 BrdSize_{i,t} + \delta_4 Dur_{i,t} + \delta_5 LogAsst_{i,t} + \mu_{i,t}$$

Here, $Gend\%_{i,t}$ is the percentage of women on the board or the gender ratio, $Indep\%_{i,t}$ is percentage of independent directors on the board, $BrdSize_{i,t}$ refers to the number of board members that period, and $Dur_{i,t}$ refers to the number of years a director may serve on the board before they are up for re-election. $LogAsst_{i,t}$ is the logarithm of total book assets and is used as a control for the size of the firm.

Based on our initial hypothesis presented above, we expect δ_1 to be negative, implying higher gender diversity reduces misattribution. Similarly, we expect δ_2 to be negative, as we believe higher percentages of independent board members will reduce misattribution. We expect larger boards to be more prone to misattribution, hence we expect δ_3 to be negative. Finally, we expect δ_4 to be positively related, as higher duration of the board would mean greater insulation of the board from shareholder pressure, leading to less misattribution.

We use $LogAsst_{i,t}$ as a control variable to control for differences in firm size and complexity. There is no existing literature to link firm size and complexity with the misattribution in CEO turnover. It can be argued that larger firms may have more complicated operations or exposure to multiple industries which would make accurate assessments of the CEOs performance more difficult compared to smaller firms with simpler operations which operate in a single industry. On the other hand, larger firms may have more resources which allow them to hire better, more skilled directors or have better governance mechanisms in place. Both these factors could reduce misattribution for larger firms compared to smaller firms with poorer governance mechanisms or less skilled directors. For our research, $LogAsset_{i,t}$ is not a variable of interest and its purpose is only to account for differences in firm size across the sample.

Section 4: Quantifying the Impact of Change in Board Characteristics

We have shown that certain board characteristics appear to reduce misattribution of CEO turnover by boards. In this section, we show our methodology for quantifying these effects.

4.1 Implied Marginal Impact of Change in Board Characteristics

The results of the model in Section 3.5 will show us if certain board characteristics are significantly affecting the misattribution made in the CEO turnover decision. Since misattribution is basically a component of the standard normal distribution value of CEO turnover probability from the model given in Section 3.2, it is hard to interpret the coefficients. Essentially, we will be showing how a 1 unit change in a certain board characteristic e.g. independent directors percentage on the board, will affect the portion of z-value of the probability of turnover of the CEO.

To make interpretations easier, we find the implied change in probability of CEO turnover when, all else held constant, there is an exogenous change in any one board characteristic. We call these impacts implied marginal impacts because:

a. These are based on predicted values from our models, not actual change in firm board.
b. These are marginal in the sense that we only show effect of change in board characteristic on the misattribution, not the effect on total probability of turnover for the CEO.

In real life, a change in board feature would likely impact both misattribution, and the portion of CEO turnover probability given by $\hat{e}_{i,t}$ (from the model in Section 3.3) i.e. the portion of returns that are correlated to CEO ability and which he should be evaluated for. For example, an exogenous change in gender ratio of the boards may, on average, reduce misattribution, as well as make the board more likely to fire the CEO for the non-industry induced part of the stock performance as well.

4.2 Empirical Methodology for Calculating Implied Marginal Impacts

We start by predicting the probability of turnover of a firm for a given year based on the models constructed in Step 2:

$$p(\hat{T}_{i,t}) = \hat{\alpha}_o + \hat{\alpha}_1 \hat{R}_{i,t-1} + \hat{\alpha}_2 \hat{e}_{i,t-1} + \hat{\alpha}_3 Tenure_{i,t} + \hat{\alpha}_4 Own_{i,t} + \hat{\alpha}_5 Retire_{i,t}$$

Since we denote $\hat{\alpha}_1 \hat{R}_{i,t-1} = \hat{m}_{i,t}$, we can rewrite the above equation as:

$$p(\hat{T}_{i,t}) = \hat{\alpha}_o + \hat{m}_{i,t} + \hat{\alpha}_2 \hat{e}_{i,t-1} + \hat{\alpha}_3 Tenure_{i,t} + \hat{\alpha}_4 Own_{i,t} + \hat{\alpha}_5 Retire_{i,t}$$

Finally, we substitute $\hat{m}_{i,t}$, the sample value of misattribution, with the predicted value of misattribution from Step 3:

$$p(\hat{T}_{i,t}) = \hat{\alpha}_o + \hat{n}_{i,t} + \hat{\alpha}_2 \hat{e}_{i,t-1} + \hat{\alpha}_3 Tenure_{i,t} + \hat{\alpha}_4 Own_{i,t} + \hat{\alpha}_5 Retire_{i,t}$$

where:

$$\hat{n}_{i,t} = \hat{\delta}_0 + \hat{\delta}_1 Gend\%_{i,t} + \hat{\delta}_2 Indep\%_{i,t} + \hat{\delta}_3 BrdSize_{i,t} + \hat{\delta}_4 Dur_{i,t} + \hat{\delta}_5 LogAsst_{i,t}$$

$p(\hat{T}_{i,t})$ is the predicted probability of CEO turnover and is calculated based on predicted misattribution in the sample.

To see the implied marginal impact, we change one of the board characteristics and predict new values of misattribution, and then predict new turnover probabilities. Assume we increase the percentage of all independent board members by 1 percentage point in all firms (note that in our sample, no firm has 100% independent directors on board). The predicted misattribution in this new case is denoted as $\hat{p}_{i,t}$ and defined as:

$$\hat{p}_{i,t} = \hat{\delta}_0 + \hat{\delta}_1 Gend\%_{i,t} + \hat{\delta}_2 (Indep\%_{i,t} + 1) + \hat{\delta}_3 BrdSize_{i,t} + \hat{\delta}_4 Dur_{i,t} + \hat{\delta}_5 LogAsst_{i,t}$$

We call this new predicted value of misattribution $\widehat{p_{i,t}}$ to differentiate from the original predicted value $\hat{n}_{i,t}$, which is based on the sample values of board characteristics. In the case for $\hat{p}_{i,t}$, we have artificially increased the value of independent directors by 1 percentage point. $\hat{p}_{i,t}$ is the predicted value of the portion of normal value of CEO turnover probability due to misattribution, if the independent directors were increased by 1 percentage point. We replace the original predicted value of misattribution in the predicted Probit model (shown previously) with the new, hypothetical predicted value of misattribution. We get a new value of CEO probability, which we denote $p(\hat{R}_{i,t})$, which is defined as:

$$p(\hat{R}_{i,t}) = \hat{\alpha}_o + \hat{p}_{i,t} + \hat{\alpha}_2 \hat{e}_{i,t-1} + \hat{\alpha}_3 Tenure_{i,t} + \hat{\alpha}_4 Own_{i,t} + \hat{\alpha}_5 Retire_{i,t}$$

We then find the difference between the predicted total probability of turnover using the sample values of board characteristics, and the predicted total probability of turnover based on new values of board characteristics. This is the implied marginal probability of changing independent directors by 1 percentage point on average. We denote implied probability as $\varphi_{i,t}$, where:

$$\varphi_{i,t} = p(\hat{T}_{i,t}) - p(\hat{R}_{i,t})$$

4.3 Interpretation of Marginal Impacts

It is important to be very careful in interpreting this result. What we are saying is not that, if there was an exogenous increase in independent directors by 1 percentage point, the probability of getting fired changes by φ. The correct interpretation is that, if a CEO is to be fired with probability $p(\hat{T}_{i,t})$ in any year t, due to a combination of misattribution and correct evaluation by the board, and then we retroactively increase the board independence by 1 percentage point, the change in probability of getting fired due *only* to reduced misattribution of performance is $\varphi_{i,t}$

The reason it is incorrect to say that the total probability of turnover will decrease, is because total probability of turnover depends on both the predicted misattribution and the sensitivity to the idiosyncratic part of stock return. A change in board characteristic is likely to affect both these factors. For example, higher percentages of independent directors may reduce predicted misattribution but may increase sensitivity to idiosyncratic part of stock return as well. To find the effect on total probability would require predicting both the effect on predicted misattribution and the sensitivity to the idiosyncratic part of stock return. However, if we try to estimate the effect of change in board characteristics on of sensitivity to idiosyncratic part of stock return, we may run into issues of endogeneity due to reverse causality. It will be hard to establish if the change in board characteristic lead to the change in return, or vice versa. Section 6 gives a more detailed discussion on this matter.

We focus on only change due to misattribution being reduced by different board characteristics, all else being constant. Assume a board which is evaluating a CEO and deciding if to fire her. First, it needs first filter out peer-induced return and isolate the return that is due to the CEO's own ability. Then, it must decide whether to fire her for the performance she is responsible for. The implied probability we calculate is as if the board brings in, for example, a new independent director (increase in percentage of independent directors on the board). The new director helps the others in filtering out peer effects. After doing this, the new director leaves, and only the original directors decide if to fire the CEO or not, based on the evaluation they did with the new director. Implied probability is the probability the CEO is fired in this hypothetical scenario.

We will calculate this implied probability for 1 percentage point change in women on the board and independent directors, and for 1 unit increase in board size and duration. The values and the results are presented at a later section in the thesis.

Section 5: Empirical Results and Analysis

We start with summary statistics of our sample, and then present the results and interpretations of our empirical methodology.

5.1 Summary statistics

Panel A in Table1 presents a summary of our CEO turnover and classification data. It shows the number of total turnovers and how many of these are (on average) classified as voluntary or forced. Our final sample has 4,159 firm-year observations from 2005-2016 and contains 213 turnovers. Of these 128 are classified as forced and 85 are classified as voluntary.

In our sample, there are more turnovers classified as forced than as voluntary. The reason is that, in our sample, turnovers are more common among poorly performing firms with low returns than among high performing firms. Since we classify turnovers as forced if the firm underperforms its peers in the prior period, it is more likely that a turnover is classified as forced rather than voluntary. Low performing firms have more turnover cases and will likely underperform their peers (so classified as forced), while high performing firms will outperform their peers (so classified as voluntary) but there are less turnover events among these firms.

Panel B shows the average firm characteristics and firm performance by CEO turnover outcome. We see that firms which dismiss their CEOs are, on average, both smaller in book value of assets and market value of equity relative to firms who retain their CEO or to firms where the CEO leaves voluntarily. Additionally, we can observe that stock returns in firms where the CEO voluntarily leaves have an average return of 40.9% across all four methodologies, compared with 15.4% for firms with forced turnovers.

Firms with voluntary turnovers are larger and better performing due to the method used to classify turnovers as forced or voluntary. Since turnover is classified as voluntary only if the firm has outperformed its peer group, high performing firms with high returns or market capitalizations are more likely to satisfy this criterion compared to firms with poor returns.

The summary statistics presented are averaged across different peer group returns i.e. Fama-French value and equally returns weighted, as well as Hoberg-Philips value and equally weighted returns. The exact values of forced turnover (and therefore firm accounting data and returns) differ for each type of peer return, since these determine the peer return that the firm will compared against to classify the turnover.

Table 1

Summary Statistics

This table presents summary statistics for the turnover data. Since turnover classification depends on the peer return used, different peer returns give different summaries. The data presented is an average of the values for each peer return used i.e. value and equal weighted returns for both Fama-French and Hoberg-Philips peer groups.

Panel A shows the number of firm-years and the average of total, forced and voluntary CEO turnovers across all peer group returns.

			CEO Turnovers		
Number of Firm-Years	Number of Forced CEO Turnovers	Number of Voluntary CEO Turnover	Percentage of Firm-Years with at Least One CEO Turnover	Percentage of Firm-Years with at Least One Forced CEO Turnover	Percentage of Firm-Years with at Least One Voluntary CEO Turnover
4,159	128	85	5.12%	3.08%	2.04%

Panel B gives the average of key accounting and returns data for firms, classified based on whether the firm experienced no turnover (CEO is Retained), voluntary turnover (Voluntary CEO Turnover) or forced turnover (CEO is Dismissed) in the year. EW and VW industry stock return refer to equally-weighted and value-weighted peer return respectively. Both are expressed as an average of the respective peer return using Fama-French and Hoberg-Philips peer groups. Dollar values are presented as reported.

	CEO Is Retained	Voluntary CEO Turnover	CEO Is Dismissed
Firm Characteristics			
Book assets ($m)	19,974	18,595	21,762
Market value of equity ($m)	17,928	25,964	16,107
Number of employees	37,127	31,805	37,579
Firm and Industry Performance			
Stock return in the 12 months before the CEO turnover	15.40%	40.90%	-7.62%
EW industry stock return in the 12 months before the CEO turnover	14.60%	15.10%	13.60%
VW industry stock return in the 12 months before the CEO turnover	15.10%	16.55%	13.80%

5.2 Results of Separating Industry-induced Return & Idiosyncratic Return

Table 2 shows the results of regressing total returns of a firm on the returns of the peer group, to separate the peer-induced return and the idiosyncratic return. As mentioned previously, the former is return due to industry factors assumed to be outside the CEO's control, while the latter is return correlated with CEO skill and ability.

The result shows a significant and positive relationship between the performance of a firm's stock return and the performance of the firm's peer group. We show that a 1 percentage point increase in peer returns will increase the firm stock return by a minimum of 0.801 percentage points (Fama-French VW returns) to a maximum of 0.8317 percentage points (Hoberg-Philips EW returns). The result supports the view that the total returns of a firm are a function of not just the skills and ability of its CEO and management (idiosyncratic return), but also of the performance of the peers and industry of the firm. From the point of view of CEO evaluation, the results imply that boards may need to filter out the industry or peer-induced component of the total return when evaluating CEO performance. Otherwise, a possible consequence could be that the board may unfairly punish or reward a CEO for financial performance that the CEO had no control over.

The residuals of this regression represent idiosyncratic returns i.e. the part of a firm's stock return that is not explained by peer returns or industry. Idiosyncratic return is caused due to other, non-industry factors which include CEO ability and skill. While CEO ability is by no means the only source of idiosyncratic returns, it is strongly correlated with idiosyncratic returns. For our analysis, we use idiosyncratic returns as a proxy for the return that is generated over and above the industry or peer performance due to the skill and ability of the CEO.

The Hoberg-Philips peer returns appear to explain a greater proportion of the variance in the firm's total stock return compared to the Fama-French peer returns, based on R-squared values. This supports the view that Hoberg-Philips gives more accurate peer groups. In addition, we see that using value-weighted peer returns gives better results than equally-weighted returns, based on R-squared values. This result suggests that value-weighted returns better captures the different exogenous factors than effect peer returns than equally-weighted returns in the sample. However, there is no reason to believe that one is necessarily better than the other in the context of our analysis.

Table 2

Regression of Peer-induced Return on Total Stock Return

Results for the regression of peer returns (referred to as industry stock returns in the table) on contemporous total stock return of the firm, to isolate the impact of peer returns on total return of the firm. The regression equation is given as:

$$R_{i,t-1} = b_0 + b_1 R_{p,t-1} + \alpha_i + e_{i,t-1}$$

Where $R_{i,t-1}$ is the lagged total return of the firm, $R_{p,t-1}$ is the lagged peer return, $e_{i,t-1}$ is the corresponding error term and α_i is the fixed effect.

Peer groups are defined based on Fama-French (FF) 48 industries and Hoberg-Philip (HP) peer groups. Peer returns are calculated as Equally-weighted (EW) and Value-weighted (VW) returns for each methodology. All t-statistics are reported in brackets and are calculated with robust standard errors clustered at the industry level. ** and *** denote significance at the 5% and 1% level, respectively.

	Regressions of Peer Returns on Total Stock Return of the Firm			
	FF - Firm Stock Return in Year t-1	FF - Firm Stock Return in Year t-1	HP - Firm Stock Return in Year t-1	HP - Firm Stock Return in Year t-1
EW industry stock return in year $_{t-1}$	0.809***		0.837***	
	(14.25)		(24.81)	
VW industry stock return in year $_{t-1}$		0.801***		0.817***
		(7.91)		(24.14)
Constant	0.0301***	0.0387**	0.0272***	0.0362***
	(3.78)	(2.74)	(5.70)	(7.18)
R^2	0.198	0.150	0.223	0.175
Observations	8879	8445	8879	8445

t statistics in parentheses
$^* p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

5.3 Results of the Impact of Peer-Induced Returns on CEO Turnover

Table 3 shows that both predicted idiosyncratic return and peer-induced return negatively affect the probability of forced CEO turnover i.e. both reduce the probability of a CEO being fired. The result holds for all peer return calculations i.e. Fama-French value- weighted and equally-weighted returns as well as Hoberg-Philips value- weighted and equally-weighted returns.

The results show that the effect of predicted peer-induced returns is greater when using Fama-French peers as compared to the Hoberg-Philips peers. The impact of idiosyncratic returns is also, on average, greater using Fama-French peers as compared to the Hoberg-Philips peers. It may be that Fama-French overestimates the effect of predicted peer-induced returns on CEO turnover probability, as it viewed as a less precise method. However, one can also argue that Hoberg-Phillips may be under-estimating the true relationship, as the peer returns in Hoberg-Philips are impacted due to missing data for many firms. Value-weighted peer returns, for both Fama-French and Hoberg-Philips, give greater impact from predicted peer-induced returns compared to equally-weighed peer returns. However, the impact of idiosyncratic returns is greater under equally-weighted peer returns, for both Fama-French and Hoberg-Philips. The results are similar in terms of magnitude and direction, regardless of which peer returns is used.

We see that the if the CEO has high stock ownership (defined as more than or equal to 5% of the shares of the firm) has a significantly negative affect on the probability of CEO turnover. This is reasonable, as CEOs with high ownership may have greater influence or power on their board, making them comparatively harder to dismiss than CEOs with low (less than 5%) ownership in the firm. We see that impact of high CEO ownership is greater when using Fama-French instead of Hoberg-Philips peer groups, and when using value-weighted peer returns instead of equally-weighted peer returns. As before, the results are similar in terms of magnitude and direction, regardless of which peer returns is used.

We see that the if CEO is of retirement age (between 63 years and 66 years old, inclusive), there is a greater the probability that she will be fired, all else constant. This result holds for all four peer return methodologies. One reason for this result could be that firms are more willing to dismiss poor performing CEOs if they are older, perhaps because the board believes the CEO is less likely of generate superior results due to age. An alternative reason could be being between 63 and 66 years old would increase the probability of being fired simply because most of the turnovers in our sample are for CEOs in the age group of 60-68. Therefore, the positive relation between turnover and CEO retirement age is formed mechanically.

Table 3

Regression of Predicted Peer-Induced and Idiosyncratic Return on Forced Turnover

Results for regressing on predicted peer-induced return ($\hat{R}_{i,t-1}$) and idiosyncratic return ($\hat{e}_{i,t-1}$) on forced CEO turnover using a probit model. We control for if CEO owns more than 5% of the firm's issued shares ($Own_{i,t}$), if CEO is of retirement age between 63 and 66 years ($Retire_{i,t}$) and CEO tenure in years ($Tenure_{i,t}$). The model is controlled for fixed effects and given as:

$$p(TO_{i,t}) = \alpha_o + \alpha_1\hat{R}_{i,t-1} + \alpha_2\hat{e}_{i,t-1} + \alpha_3 Tenure_{i,t} + \alpha_4 Own_{i,t} + \alpha_5 Retire_{i,t} + \varepsilon_{i,t}$$

The probabilities are calculated using the predicted stock returns and residuals from Table 2. Peer groups made from both Fama-French (FF) and Hoberg-Philips (HP) grouping, for both value-weighted and equally-weighted peer groups. The z-statistics in the brackets below are all calculated using robust standard errors, clustered at the industry level. Time fixed effects are also controlled for. ** and *** denote significance at the 5% and 1% level, respectively.

	Regression of Forced CEO Turnover on Peer-Induced Returns			
	Value Weighted Industry		Equally Weighted Industry	
	(FF) Forced CEO Turnover	(HP) Forced CEO Turnover	(FF) Forced CEO Turnover	(HP) Forced CEO Turnover
Industry-induced stock return in year t-1	-0.659***	-0.395**	-0.616***	-0.388**
	(-5.40)	(-2.90)	(-4.91)	(-2.98)
Idiosyncratic stock return in year t-1	-1.217***	-1.306***	-1.349***	-1.353***
	(-11.95)	(-12.09)	(-11.95)	(-11.82)
CEO with high equity ownership	-0.567***	-0.506***	-0.603***	-0.520***
	(-4.41)	(-4.08)	(-4.57)	(-4.15)
CEO tenure in years	0.00752	0.00744	0.00773	0.00903*
	(1.90)	(1.84)	(1.77)	(2.13)
CEO of retirement age	0.354***	0.348***	0.382***	0.343***
	(4.83)	(4.61)	(5.01)	(4.48)
Constant	-2.236***	-2.531***	-2.287***	-2.343***
	(-15.58)	(-14.08)	(-14.01)	(-13.94)
Observations	8879	8445	8879	8445

Z statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.4 Impact of Changing Peer Return on Forced CEO Turnover Probability

An interesting question is how the probability of forced CEO turnover changes as the peer performance improves. A reduction in peer performance would increase the probability of forced CEO turnover, all else equal. This is because a lower peer return would negatively impact the firm's stock return, as we saw from the results of Table 2 and increase the probability of forced turnover based on the results from Table 3.

Table 4 shows the implied probabilities of forced CEO turnover. The implied probabilities show the probability of a CEO being fired using the results from the regressions shows in Table 2. We find the implied probabilities from using both Fama-French and Hoberg-Philips peer groups as well as value and equally-weighted returns for each and take the average of the values. We see the base case, where all independent variables are kept at their original values and compare them to the probabilities for when the peer return is changed to the value of the 10th, 25th, 75th and 90th percentile for peer returns.

As can be seen in the table, going from the 10th percentile to the 90th percentile of peer group returns almost halves the probability of a CEO being fired. The implication of the result is that the board may be affected by the industry or peer performance when evaluating the CEO. A CEO is more almost twice as likely to be fired when the peer returns are in the 10th percentile, perhaps due to industry shocks or recessions, no matter what her skill or ability or effort. However, in case of an economic boom with peer returns in the 90th percentile, the probability that she will be fired is reduced by almost 50%. This is despite the fact that the effort or skill of the CEO, proxied by idiosyncratic return, is held constant. There can be various justified reasons for industry and peer returns to play such a strong role in the probability of the CEO being fired, but we cannot rule out the possibility that the board may have unfairly blamed the CEO for the poor returns due to lower peer returns. Therefore, while these results demonstrate that boards are not fully filtering out outside factors when deciding to fire the CEO, we make no claims about if this lack of filtering is justified or not.

It is worth noting that the implied probabilities for all four peer returns are rather close to each other in value. Comparing the implied probabilities for the 10th and 90th percentile shows that Fama-French tends to give higher implied probabilities of turnover compared to Hoberg-Philips at the 10th percentile. However, if peer return is at the 90th percentile, Hoberg-Philips gives higher implied probabilities. It is interesting to note that the implied probabilities change very little if we use equally-weighted instead of value-weighted peer returns. Table 3 showed

that the choice of return metric had some influence on the probability of CEO being fired due to peer-induced returns.

One reason for observing no discernible effect between equally-weighted and value-weighted returns could be that the implied probabilities are rather small, around 3.47% to 3.59% in the base case. This may mean that any difference caused due to changing equally-weighted return to value-weighted return is rather small and does not affect the probability of CEO turnover too much. This also suggests that it does not matter too much how board evaluates the CEO, in terms of using equally-weighted or value-weighted peer returns.

Table 4

Implied probabilities for changing peer return from 10th to 90th percentile

The implied probabilities of a forced CEO turnover are calculated using the regression coefficients from Table 3. In base case probability, all independent variables are set to their actual values. Implied probabilities are calculated by averaging predicted probabilities of forced turnover for each grouping method and peer return for all observations. The peer-induced return is calculated as the predicted value of firm stock return from the regression in Table 2. Peer-induced returns are then set to their 10th, 20th, 50th, 75th and 90th percentile values and implied probability is then recalculated in each case. The other independent variables, including idiosyncratic return, are kept constant.

	(FF - VW) Probability of CEO dismissal	*(FF - EW)* Probability of CEO dismissal	*(HP - VW)* Probability of CEO dismissal	*(HP - EW)* Probability of CEO dismissal
Base Case	3.48%	3.47%	3.48%	3.59%
10 percentile	4.91%	4.95%	4.54%	4.61%
25 percentile	4.06%	3.47%	3.87%	4.00%
75 percentile	3.00%	2.95%	3.13%	3.17%
90 percentile	2.47%	2.35%	2.71%	2.73%
Observations	8879	8879	8445	8445

5.5 The Impact of Board Characteristics on Misattribution in CEO Turnover

Table 5 shows the results of how the board characteristics impact predicted misattribution in CEO turnover decisions. We defined predicted misattribution as the impact of predicted peer-induced return on the probability of forced CEO turnover.

The results show that higher percentage of women on the board are generally not significant predictors of misattribution. This implies that higher percentages of women in the board are not likely to affect the tendency of the board to be influenced by peer returns when deciding to fire or retain the CEO. It may be that women directors are as likely as their male counterparts to hold the CEO responsible for peer-induced returns. An alternative argument could be that women are under-represented in boards and the reason for percentage of female directors not significantly impacting predicted misattribution is due to their under-representation. In such a case, were the firms to improve the gender balance of boards, the results may be different.

In contrast, board size is significant for all regressions except for Fama-French equally weighted peer return. The results show that larger boards are less likely to filter out peer performance from CEO dismissal decisions and they are more prone to misattribution. One reason for this could be that larger boards may have directors who are not closely monitoring the CEO and so are less able to separate peer-induced returns from total returns of the firm. This view is supported by the finding that firms with smaller boards are more likely to have superior financial condition and performance (Yermack, 1996). However, it must be noted that there is no "correct" board size for a firm and board size depends on the industry and other factors. In our analysis we aggregate data for multiple industries, so we cannot be sure how board size effects the tendency to misattribute. Additionally, as mentioned before, using peer returns for evaluation may be justified in some cases, so it is not correct to say larger boards always do a worse job of evaluating the CEO compared to smaller boards.

Board Duration is significant for all four regressions and an increase in the duration of the board increases the level of misattribution in CEO firing decisions. However, duration may not be a reliable predictor. Most of the firms in our data have board durations of 1 or 3 years, so the results are sensitive to how we define a "long" duration board. In Table 5, long duration is defined as duration of more than 3 years, and the result is significant. Redefining long duration as more than 2 years gives insignificant results. Due to this unreliability of the results and the fact that there is no "right" board duration, we cannot be sure of the true impact of board duration on predicted misattribution.

The percentage independent directors are shown to have a strongly negative affect the predicted misattribution, implying that higher percentages of independent directors make a board less likely to be influenced by peer returns when making turnover decisions. It is significant at for all cases, so the results appear reliable.

This finding implies that predicted misattribution may be a problem of evaluation by the board. While there are justifiable reasons to consider peer returns when evaluating CEO performance, if attributing peer performance to the CEO was due to reasonable reasons, we would expect higher percentages of independent directors to *increase* predicted misattribution. More independent directors are shown to lead to higher sensitivity of CEO turnover to performance (Masulis & Guo, 2015). If attributing peer performance to the CEO was the correct performance evaluation, higher percentages of independent directors would increase tendency or sensitivity of turnover to peer returns. The fact that we document a negative relationship between the two variables would suggest that the board was originally making some type of error in their evaluation, which could be rectified by increasing the percentages of independent directors. We do not claim that all misattribution is due to incorrect board evaluation, only that the relationship we see appears to suggest that it is very much possible.

We see that the impact of peer returns and idiosyncratic returns on CEO turnover is stronger if the equally-weighted peer returns are used compared to value-weighted returns. There could be economic rationales for this finding. Perhaps it is more common to use equally-weighted returns in evaluating performance which is why it shows a greater impact. Value-weighted returns may not be used that commonly, so they are less strongly related to CEO turnover. While it may be common in certain industries or firms to use equally-weighted returns to evaluate performance, we see no evidence to show that such is the case here.

We would suggest that the reason is simply that equally-weighted returns are likely to exhibit greater variation than value-weighted returns. In any peer group, some firms may have abnormally high (or low) returns in a period. Abnormal returns may be more common for small growth firms rather than large, mature business. In this case, value-weighted peer returns may be exhibiting less variation than equally-weighted returns, since the low weight given to the outlier firm will counter the effect of abnormal return. The larger impact of equally-weighted peer returns is not due to any economic reason but simply a result of the greater variation in returns shown by equally-weighted peer returns.

Table 5

Regression of Board Characteristics on Predicted Misattribution

In the four regressions below, we regress the predicted misattribution using the regressions shown in Table 3 on the following board characteristics: Percentage of women ($Gend\%_{i,t}$), board-size ($BrdSize_{i,t}$), duration of the board ($Dur_{i,t}$), and the percentage of independent directors ($Indep\%_{i,t}$). Size of the firm is controlled for using logarithm of total book assets ($LogAsst_{i,t}$). The model is controlled for fixed effects and given as:

$$\hat{m}_{i,t} = \delta_0 + \delta_1 Gend\%_{i,t} + \delta_2 Indep\%_{i,t} + \delta_3 BrdSize_{i,t} + \delta_4 Dur_{i,t} + \delta_5 LogAsst_{i,t} + \mu_{i,t}$$

Predicted misattribution is calculated as the model coefficient for peer return in Table 3 times the lagged peer-induced return. Logarithm of firm's total book assets is used as a control variable for firm size. We control for time fixed effects and use robust standard errors for all regressions. The z-statistics in the brackets below are all calculated using robust standard errors, clustered at the industry level. Time fixed effects are also controlled for. ** and *** denote significance at the 5% and 1% level, respectively.

Regression of Board Characteristics on Predicted Misattribution				
	Value Weighted		Equally Weighted	
	(FF) Misattribution	(HP) Misattribution	(HP) Misattribution	(FF) Misattribution
Women %	-0.00141	-0.000476	-0.000740*	-0.000439
	(-1.88)	(-1.39)	(-2.11)	(-0.77)
Board Size	0.00745**	0.00583***	0.00497**	0.00412
	(2.97)	(3.58)	(2.85)	(1.81)
Board Duration Before Election	0.0600***	0.0297**	0.0368***	0.0545***
	(4.47)	(3.20)	(3.68)	(3.92)
Independent Directors %	-0.00171***	-0.00117***	-0.00129***	-0.00213***
	(-4.05)	(-3.34)	(-3.75)	(-5.22)
Log of Total Assets	-0.00796*	-0.00785**	-0.00895***	-0.0121***
	(-2.44)	(-3.22)	(-3.46)	(-3.84)
Constant	-0.0804	-0.0333	0.00596	0.0366
	(-1.82)	(-1.02)	(0.18)	(0.92)
Observations	4159	4011	4011	4159
R^2	0.0100	0.0093	0.0104	0.0108

t statistics in parentheses
$^* p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

5.6 Implied Probabilities from Change in Board Characteristics

Using the methodology explained previously, we calculate the implied probabilities of changing the board characteristics. This is the change in predicted CEO turnover probability due to a change in predicted misattribution caused by a varying the board characteristics. The results are shown in Table 6. Note that we do not show the results for change in percentage of women on the board as it was shown to be insignificant.

The base case is the probability of being fired given the predicted values from the sample. We see that increasing board size by 1 person, in case of value weighted peer returns, increases the probability of being fired due to misattribution, from 3.42678% to 3.44318% for Fama-French value weighted peer returns. This is a reduction of 0.0007% in total probability of getting fired. Similarly, in the case of Hoberg-Philips value-weighted returns, the change is from 3.28675% to 3.12%.

Increasing the percentage of independent directors on the board will reduce probability of misattribution by 0.01% compared to the base case for value weighted returns, and by 0.015% in case of equally weighted returns of peers.

For Duration (high), we make all the firms in the sample high duration (duration more than 3 years). We see an increase in misattribution of 0.07% for the value weighted peer returns and 0.03% for the equally weighted returns. If we force all firms to have low duration boards (3 years or less duration), we see that the probability of being fired decreases by 0.04% due to lower misattribution in cases of value weighted returns, and by 0.14% in cases of equally weighted returns.

While these changes in probability may appear insignificant, we would point out that this is more due to methodological approach than actual economic rational.

Table 6

Summary of implied marginal probabilities due to change in board characteristic

For each peer group method, both as value-weighted and equally-weighted peer return, the implied probabilities are calculated as the average for all the observations. Implied probabilities are defined as the change in probability of forced CEO turnover due to a change in predicted misattribution caused because of a change in the board characteristics. The change in predicted misattribution can be estimate using the results of Table 3. This value is defined as *implied misattribution.* Implied misattribution is used to find the new CEO turnover probability, keeping idiosyncratic return constant at the original level. The values can be interpreted as the probability of CEO turnover that would occur, on average, if the board characteristic was changed to a higher or lower value.

	Value Weighted		Equally Weighted	
	(FF) Prob. Forced CEO Turnover	*(HP)* Prob. Forced CEO Turnover	*(HP)* Prob. Forced CEO Turnover	*(FF)* Prob. Forced CEO Turnover
Base Case	*3.42678%*	*3.28675%*	*3.30115%*	*3.12471%*
Increase Board Size	3.44318%	3.30377%	3.31671%	3.12726%
Independent 5%	3.39243%	3.27092%	3.28336%	3.08389%
Duration High	3.59484%	3.36331%	3.40002%	3.26238%
Duration Low	3.40081%	3.27922%	3.29148%	3.09902%
Observations	4159	4011	4011	4159

5. 7 Change in Implied Probabilities Across Performance Quartiles

A relevant question that may be asked is how the effect of changing board characteristics on CEO misattribution changes with firm performance and the existing board characteristics of the firm. It may be that the effect of increasing independent director percentages on CEO misattribution is lower for firms with higher existing levels of independent directors. This would imply a form of decreasing returns to scale for the effect of these board characteristics.

Table 7 shows how predicted misattribution changes across quartiles. We show how an increase in 5 percentage points in independent directors and 1 person increase in board size changes the predicted misattribution between firms in the bottom and top quartile (*low* and *high* respectively in the table) and the middle half of the firms. The quartiles are made with respect to the characteristic i.e. bottom quartile of firms by percentage independent directors. We focus on comparing the average predicted misattribution for independent directors and board size. The reason is that board duration is shown to be a rather unreliable predictor, so we do not consider it for this analysis.

We see that the change in implied probabilities (in basis points) is not much different for the top and bottom quartile i.e. 25th and 75 percentiles, for independent directors and board size i.e. in Table 7, for By Independent Directors and By Board Size, the change in basis points is similar for both the 25th and 75th quartiles. This implies that it does not matter how large a percentage of independent directors or board size a firm already has. The impact of changing percentage of independent directors or board size will be almost the same, regardless of if the firm already has a large or small board size or percentage of independent directors.

Table 7 also shows the effect by firm performance i.e. By Performance & Independent Directors and By Performance & Board Size, for the 25th and 75th percentile. We see that the impact of a change in board characteristic on CEO turnover is sensitive to the performance of the firm. Across all methodologies tested, firms in the bottom quartile by performance exhibit a markedly greater change in implied probability than firms in the top quartile by performance. For example, under Fama-French value-weighted returns, a 5-percentage point change in independent directors reduce implied probability by 4.3 basis points in the 25th quartile but by only 1.056 basis point in the 75th percentile. The better performing firms are less effected. While these changes are small in themselves, there is a large difference if they are compared with the other changes in implied probability.

Put another way, a change in percentage of independent directors or board size will have a greater impact on predicted misattribution and CEO turnover probability, if the firm in question was a low performing firm in terms of total returns.

There are a few caveats to consider. First, as our data summary will show, poor performing firms are more likely to have turnovers in our sample, so the average predicted return for the top quartile is based on fewer values that the bottom quartile, since there is less CEO turnover in the top performing firms. Additionally, it may be argued that it would be better to regress separately both the quartiles and then compare coefficients for misattribution for each. While this approach may be theoretically better, there is insufficient turnover data for a reliable regression of each quartile separately.

We mention that industry-induced factors may be linked to CEO turnover for logical reasons i.e. CEO skills better revealed in recession with low industry returns etc. However, our analysis appears to suggest that the link between industry-induced return and CEO turnover indicates some form of bias by the board. The reason is that low performing firms tend to see a greater *reduction* in predicted misattribution than high performing firms. According to prior research, recessions and poor industry performance may lead to higher CEO turnover due to CEO-firm mismatch or CEO skills shown to be poor. These are justifiable reasons for there to be a link between industry-induced and CEO turnover. However, in such a case, greater percentages of independent directors should lead to more firings (more strict boards), as board independence is correlated with CEO turnover.

Misattribution in our model is sensitivity to industry-induced returns. This could be due to poor evaluation or a justifiable reason, as mentioned above. However, if there is a recession or poor industry performance, that may show that the CEO is lacking in skill or mismatched to the firm. In this case, we would expect increase in board independence to *increase* sensitivity to industry-induced returns (misattribution) i.e. an increase in misattribution due to increase in percentage of independent board members by 5%. The fact that there is a decrease means higher board independence leads to lower sensitivity to industry-induced turnover for poor performing firms. The reduction in predicted misattribution due to a higher percentage of independent directors may imply that the board originally evaluated improperly. The board may have blamed the CEO for peer-induced return and fired her for that. However, this is just one explanation for the negative relation we see between predicted misattribution and percentage of independent directors

Table 7

Change in implied probabilities by quartiles

By Independent Directors and By Board Size refer to separating firms into quartiles based on sample values of percentage of independent directors and board size respectively, and then calculating the change in implied probability due to change in independent directors by 5 percentage points and board size by 1 person. By Performance & Independent Directors is created by separating firms into quartiles based on total return, and then calculating change in implied probabilities due to change in independent directors by 5 percentage points or due to change in board size by 1 person, respectively. There are 4159 observations under the Fama-French (FF) grouping, and 4011 observations under the Hoberg-Philips (HP) grouping. Predicted misattribution and implied misattribution are calculated based on the results shown in Table 2 and 4.

| | Change in Implied Probability | | | |
	FF Value Weighted	HP Value Weighted	FF Equally Weighted	HP Equally Weighted
By Independent Directors				
25th Percentile	-2.679	-1.633	-3.072	-1.868
Median	-2.838	-1.739	-3.26	-1.971
75th Percentile	-2.838	-1.739	-3.26	-1.971
By Board Size				
25th Percentile	2.397	1.685	1.225	1.477
Median	2.336	1.603	1.191	1.418
75th Percentile	2.352	1.607	1.222	1.434
By Performance & Board Size				
25th Percentile	3.761	2.628	1.942	2.232
Median	2.396	1.64	1.447	1.467
75th Percentile	0.925	0.648	0.483	0.632
By Performance & Independent Directors				
25th Percentile	-4.3	-2.638	-4.974	-2.901
Median	-2.737	-1.645	-3.137	-1.907
75th Percentile	-1.056	-0.649	-1.233	-0.821

5. 8 Conclusion of Analysis

Overall, we see that boards consistently misattribute CEO performance and hold the CEO responsible for peer-induced or industry returns when making CEO turnover decisions. Higher peer-induced returns (that are not correlated with CEO ability) as well as higher idiosyncratic returns (that are correlated with CEO ability) both reduce the probability of a forced CEO turnover. Higher percentage of independent directors, higher board size and (to a lesser extent) lower duration of board can reduce the tendency of the board to misattribution peer-induced returns to the CEO. We document a strong negative relationship between misattribution and independent director's percentage on the board. This would suggest that lower misattribution may desirable in terms of CEO evaluation. However, this is by no means proved by our analysis and there may be strong reasons for evaluating the CEO against peer group returns.

The sensitivity of misattribution to change in board characteristics is affected by if the firm is question is a high or poor performer in terms of stock returns. The impact of change in board characteristics appears to be greater for firms that are in the bottom quartile in terms of total returns compared to firms in the top quartile. However, there is no difference for firms in the top and bottom quartile by the board characteristic itself, suggesting that the impact of change in board characteristic would be almost same for a firm with, for example, a high percentage of independent directors compared to one with al a low percentage of independent directors.

Our findings contribute to the existing literature by showing that not only is misattribution present, but this tendency to attribute peer or industry performance is affected by the certain characteristics of the board, and that the impact of these characteristics on misattribution is higher for firms suffering from low returns.

Section 6: Econometric Concerns

In any empirical study, there are various econometric and methodology concerns which can cause misleading results. In this section, we highlight some of the most common ones encountered in our research. We show how we control for common econometric issues in panel data. We then discuss the issue of reverse causality. Finally, we discuss an alternative method used in literature, for capturing misattribution

6.1 Methodology Concerns Related to Panel Data

Since we are dealing with panel data over multiple time periods, the first main concern is about controlling for time invariant effects that could distort our findings. We control for these in all by using fixed effects models in all our models. It may be tempting to random effects models instead of fixed effects. Our view is that, given we have multiple firms over different industries, our results are likely to be impacted by time-invariant factors like firm culture, leadership etc. than by random exogenous factors. Therefore, fixed effect models are better to use to control for firm and industry time-invariant effects.

Another problem in dealing with panel data is that of heteroskedasticity. This can distort our standard errors for the variables, causing us to get distorted results for their significance (or lack of). To control for this issue, we use heteroskedasticity robust errors in all our regressions.

An issue may be that the relation between board characteristics and CEO turnover may be non-linear in Section 3.5, whereas we show a linear relation between the variables. However, we calculated results of using non-linear variations of the board characteristic e.g. logarithms and natural log of variables, squared terms etc. None of them were found to be significant. Therefore, the linear model in Section 3.5 is unlikely to mis-specify the economic relationship between the variables. This makes intuitive sense as well, as in Section 3.5 we are regressing board characteristics on the standard normal value of CEO turnover, not the CEO turnover itself. We may expect independent directors or the other board characteristics to have a non-linear (e.g. U-shaped) relation to CEO turnover, but it is unlikely to be so for part of the z-value of CEO turnover probability

6.2 Controlling for Reverse Causality and Endogeneity

A major concern in any governance research is the problem of reverse causality. Indeed, research shows that not only do changes in governance cause change in performance and CEO turnover but change in performance and turnover also influence the governance and board characteristics. We have attempted to structure our approach in a way as to avoid this issue.

We believe reverse causality is not a large concern in the model from Section 3.2. It is unlikely that, on average, a single firm's results could cause change in the returns of its entire peer group. However, it reasonable that the peer or industry return could influence a firm stock return. Of course, this may not be the case for a specific industry. In industries that are dominated by one large firm, the return of that firm may have a strong influence on the returns of the whole industry. In our sample, it may also be that in industries where data for only a few firms is available i.e. small peer groups, one firm may influence the overall peer return. This situation is more likely when using the Hoberg-Philips peer grouping compared to Fama-French grouping, as the former is more narrowly defined. However, we see that both methods give similar results. Additionally, such with very small peers are rare in our sample and should be considered outliers. Across the full set of all firms and peer groups in the sample over the period considered, a single firm is unlikely to consistently affect the returns of its industry or peers.

For the model shown in Section 3.3, we see no reason for reverse causality. The lagged predicted peer returns should not be affected by if the CEO was fired or not this year.

We now discuss the model from Section 3.5. It must be noted that we are not regressing CEO turnover on the board characteristics (which has a problem of reverse causality). Rather, we are regressing *a component* of the standard normal value of CEO probability with the board characteristics. From Section 3.3, misattribution is calculated as is mathematically the lagged peer returns multiplied by a constant. Therefore, there is no danger that a change in misattribution (change in lagged predicted peer returns), could influence the board features in the current period. It can be argued that a firm may change its board features post turnover because it knows that there was misattribution in the turnover, but we feel this is unlikely since:

1. Misattribution is an unobservable variable
2. If the board was aware of misattribution happening in the time of the turnover decision, they would have changed or modified their decision and dealt with it.

Preventing issues of reverse causality is also the reason that we only change the values of board features for misattribution when calculating implied marginal probabilities. When calculating the effect of change in board characteristics on misattribution, we keep constant the sensitivity to idiosyncratic part of returns. While it is logical that a change in board feature will affect both misattribution and then sensitivity to idiosyncratic part of returns, we cannot we sure if there is reverse causality in the case of the latter. The reason is that these returns are correlated with

CEO ability and skill. It may be that higher independent directors lead to better evaluation of CEO performance. On the other hand, if there is a decline in CEO ability and skill, the firm may hire more independent directors or women etc. to monitor the CEO more closely. Hence, it is not clear that reverse causality is absent in this case. Therefore, we keep sensitivity to idiosyncratic part of returns constant when calculating implied probabilities.

A result of the above method, our values for the change in turnover probability due change in board characteristics appear rather small and unremarkable. This is because we ignore the effect of change in board characteristics on sensitivity to idiosyncratic part of the returns. However, we would point out that our main finding is the fact that board characteristics are indeed significant in predicting misattribution in turnover, and it would be wrong to dismiss this finding simply because the overall probability does not change much.

It should be noted that reverse causality is obvious source of endogeneity in CEO turnover research, which is why we focus detail on how we manage it. However, there are other sources of endogeneity which may affect our results. Omitted Variable Bias can be a problem in our analysis, as there is insufficient data available to control for the various other board characteristics of a board. These omitted variables, therefore, can cause endogeneity in our analysis. Therefore, while we have taken steps to ensure reliable results, we cannot rule out endogeneity entirely from our analysis.

6.3 Alternative Methodologies

We present an alternative methodology used in prior literature (Barro & Barro, 1990). The purpose is to see if this alternative methodology may be useful or better than the methodology we apply. The model used by Barro is given as:

$$p(Turnover)_{i,t} = \pi_o + \pi_1 r_{p,t-1} + \pi_2 r_{i.t-1} + \mu_{i,t}$$

In this model, we use a probit model with lagged peer returns ($r_{p,t-1}$) and lagged stock return ($r_{i.t-1}$) as predictors. Compared to our method, in this case, we are not isolating predicted peer-induced and idiosyncratic returns and instead are regressing on peer or industry returns and the total stock return. We would expect the former to be positively and the latter to be negatively related to probability of CEO turnover.

One may argue that we can proxy misattribution using the term $\pi_1 r_{p,t-1}$ and use this methodology instead of the two-step method we use. However, this methodology assumes only partial filtering of the results so the misattribution we see is not the total misattribution i.e. the

method is likely to under-report misattribution in CEO turnover (Jenter & Kanaan, 2015). An additional issue is that including both peer and firm returns makes the coefficients hard to interpret for our purposes.

It may be tempting to put the board characteristics in the above equation as a method to see the impact of board characteristics on CEO turnover. For example, we may estimate:

$$p(Turnover)_{i,t} = \pi_o + \pi_1 r_{p,t-1} + \pi_2 r_{i.t-1} + \acute{B}\acute{X} + \mu_{i,t}$$

Here, $\acute{X}$ represent the vector of all the board characteristics to test e.g. independent directors, women on the board etc. This method is attractive since we can find the sensitivity of CEO turnover to board characteristics. However, here we will run into the problem of reverse causality. We cannot be sure that the change is board characteristics is causing the change in CEO turnover probability. As has been shown by research, CEO firings and firm performance may lead to changes in board characteristics, as well as the other way around (Hermalin & Weisbach, 1988).

We conclude that, given the above points, our methodology can avoid common modelling problems and give reliable results compared to other methods and alternatives. We would point out that there is an alternative to using probit or logit models in estimating CEO turnover probabilities, and that is to use Cox Proportional Hazards model. This is the method used by by Jenter (Jenter & Kanaan, 2015). While we have not tested this method, we feel that it is unlikely to contradict our findings. This is because it is shown that the Proportional Hazards model and logit models give similar results in the analysis. We use a probit model, which is generally viewed as giving similar results as logit models. Hence, we feel that our results and findings would hold were the Proportional Hazard model to be used.

6.4 Robustness of Turnover Classification

The classification method to separate forced and voluntary turnover is a sensitive parameter for our analysis, so we check for the robustness of our classification method. We test changing the extent to which the firm must underperform its peers e.g. underperform by 10% etc. before the turnover is classified as forced. We see that our results are not greatly impacted by this. We also check results from using age-based classification criteria and results if we impose restriction on CEO not getting of new job. The results from these tests, as well as a discussion on turnover classification methods is presented in the Appendix.

Section 7: Data Descriptions & Summary Statistics

In this section, we present summaries of our data and data sources. We start with presenting our data sources and sample construction. We then present summaries of accounting and returns data in our sample, followed by summaries of the turnover and governance data for our sample.

7.1 Data Sources and Sample Construction

We gather the data on monthly stock returns, share price and shares outstanding from the CRSP database for the period 2005-2016. We limit ourselves to data from only those firms that are listed on the US stock exchanges. The returns data is subsequently sorted, cleaned and annualized.

Data on CEO characteristics and turnover data is from the Execucomp database for the same period. We gather accounting data for the firms from Compustat and data on the relevant governance variables using DataStream. We create peer groups using the Fama-French segments using the firm SIC codes from CRSP and the classification scheme provided by Ken French. Hoberg-Philips peer groups are based on data from the Hoberg-Philips Data Library.

It is important to note that data on annual return, turnover, accounting variables and governance variables is not available for each firm in CRSP and Compustat. Additionally, data for Hoberg-Philips peers is also not available for all the firms in CRSP and Compustat. Our sample, therefore, is not simply the set of firms in CRSP and Compustat, but the set of firms in CRSP and Compustat for which we have peer group and governance data available. Firms with missing data or partial data are removed from our sample.

Detailed descriptions of variable construction, data structuring and the peer grouping techniques are provided in the Appendix.

7.2 Accounting & Returns Data

Our sample consists of a total of 942 firms covering the period 2005-2016. This translates into a total of 4159 firm-year observations for Fama-French peer group methodology, and 4011 firm-year observations for Hoberg-Philips peer group methodology. Table 8 shows the summary statistics for various accounting and returns data for our sample. Since we do not restrict our sample to firms above a certain threshold market capitalization, there is a wide range of values for the accounting and returns variables. As a result, we show the values of the 10th and 90th percentiles as well as the mean value for each variable.

Table 8

Data Summary by Percentile of Accounting Variables for the Sample

Panel A gives the key accounting data for the firms in the sample. To prevent abnormally high or low values from effecting the reported data, 10th and 90th percentile values for each accounting variable are shown, along with the sample mean of the variable. Dollar values are presented in millions USD as reported at the time. Total Share Return is the average total stock return of the firms in the 10th and 90th percentile by return. Mean Total Share Return refers to the average total return of all firms in the sample. The summary statistics is based on total of 8879 observations.

	10th Percentile	90th Percentile	Mean
Assets ($M)	293	20,732	12,317
Market Capitalization ($M)	313	21,016	10,329
Employees	654	51,900	23,435
Turnover / Sales ($M)	254	15,651	7,829
Total Share Return	-35.5%	62.9%	15.4%

It can be seen from Table 8 that the sample means for the accounting variables are closer to the 90th percentile values than the 10th percentile values. For example, in the case of market capitalization, the sample average is $10.329 billion and the 90th percentile is $21.016 billion. However, the 10th percentile is only $313 million. This suggests that our sample is biased toward larger firms. This is to be expected since turnover data is more commonly available for larger firms compared to smaller firms. Since we exclude firms for which we do not have such data, our sample is skewed toward larger firms.

We see that the there is a large range of total stock returns in our sample, with the bottom 10th percentile of firms having an average stock return of -35.5% and the top 10th percentile having an average stock return of 62.9%. The average return for the sample is 15.4%.

This data suggests that there may be outliers in the data, with some firms having abnormally high or low returns. However, outliers are a minor problem in our methodology. The reason is that we will be comparing the returns of a firm to its peers, so the effect of an outlier will be restricted to the firms in that peer group, and not affect the other peer groups.

Additionally, there is no strict test to check if a return is abnormal. A firm may appear to have abnormally high return when we look at the total sample, but it may be reasonable for that industry or peer group. Removing outliers will therefore require arbitrary criteria for what is "normal return" for a peer group. By using multiple peer group methodologies, we can make our results robust to effects of outliers without removing the outliers based on some arbitrary criteria.

7.3 CEO Turnover Data Summary

We present the statistics regarding CEO turnover in our sample in Table 9. We show the number of CEO turnovers classified as forced or voluntary as per our classification method, as well as the number of retained CEO in the sample. Our classification of forced turnover depends on the type of peer return (value weighted or equal weighted) and the peer group methodology (Fama-French or Hoberg-Philips) so we show the respective number of forced or voluntary turnovers for each case. Detail description of the turnover data is provided in the Appendix.

Table 9

Turnovers Events in Sample by Data Availability

The table shows the number of forced turnovers under each peer return for which there is only accounting and return data available and for which full data, including board information, is available. There is limited data on board characteristics compared to accounting and return data. CEO Fired, CEO Voluntary Turnover and CEO retained refer to the classification of the turnover.

	FF Value Weighted	HP Value Weighted	Equally Weighted	HP Equally Weighted
Returns and Accounting Data				
CEO Fired	306	287	296	291
CEO Voluntary Turnover	157	155	167	151
CEO Retained	8416	8003	8416	8003
Full Data				
CEO Fired	132	124	128	126
CEO Voluntary Turnover	86	83	90	81
CEO Retained	3941	3804	3941	3804

Table 9 shows the CEO classifications for data estimating the misattribution (Returns and Accounting Data) and data for estimating effect of governance on predicted misattribution (Full data).

We see that CEO turnover is a rare event in our data. For example, for Fama-French value weighted results, there are 463 turnovers (forced and voluntary) compared to 8416 retained CEOs. We see further that if we were to only focus on the firms where we have governance data, we would lose more than half of the observations for CEO turnover and CEO retained. That is why we estimate misattribution on the returns data and then use that to estimate effect on governance on the subsample of firms for which we have governance variables. Restricting the sample to only firms for which we have full data would significantly reduce the number of firms and turnovers in our data, leading to wrong results.

7.4 Governance Data Summary Statistics

Table 10 shows the summary of the governance variables in our sample. As mentioned previously, firms with governance data are a subset of our overall sample. Since there is a large range of values taken by different governance variables, we present our data in terms of sample average value of the variable, and the values of the 10th and 90th percentile for that variable. This is to give a better idea of how the different variables are distributed in our sample.

Table 10 shows that the sample average of board size is approximately 9 people. Of the firms in the sample, the 10th percentile of firms in terms of board size has 7 directors, while the 90th percentile of firms in terms of board size as 12 directors. Hence there is not too much variation in absolute board size in our sample. A similar analysis applies for the other variables. It is interesting to note that CEO Ownership and Tenure seem to show a greater range of values in the sample compared to board characteristics. Most firms have board characteristics that appear, in most cases, to not change too much between the 10th and 90th percentiles. However, CEO Ownership is 0.77% in the 10th percentile and 4.9% in the 90th percentile. CEO Tenure percentiles are between 2 and 18 years. This would indicate that while most firms have board characteristics that

Table 10

Summary of Board Data in the Sample

This table shows the summary statistics of the board characteristics under question: Board Size, Percentage of Independent Directors, Percentage of Women, and Board Duration. Data is also given for CEO Tenure, and CEO ownership of firm equity as percent.

To prevent an outlier from giving misleading understanding, we summarize each variable by showing its value for the 10th and 90th percentile, as well as its mean value in the sample. Board Size, Board Duration and CEO Tenure are integers, the other variables listed as percentages.

	10th Percentile	90th Percentile	Mean
Board Size	7	12	9.3
Independent Directors %	66.67%	90.9%	80.96%
Women On The Board %	0%	25%	12.9%
Board Duration	1	3	2.35
CEO Equity Ownership %	0.77%	4.9%	2.35%
CEO Tenure in Years	2	18	9

Board Duration in our sample is an integer between 1 and 5, showing the number of years before the directors are up for re-election. In our analysis, we use a dummy variable to classify board duration as either "short" (3 years or less), or long (more than 3 years). The summary presented in the table is for the actual values of board duration. We see that, in terms of board duration, the 10th percentile has an average duration of 1 year, meaning that directors are up for election each year. The 90th percentile in terms of board duration have an average duration of 3 years. The reason for using a board duration dummy is to see the impact of having longer board durations (more than 3 years, which is less common in the data) on predicted misattribution.

7.5 CEO Turnover and Accounting data

Data for CEO turnover is obtained from the Compustat/Execucomp database for the period 2005 to 2016. The database gives details on the CEO and other executive officers of US firms, including (but not limited to) age, date of joining the company, date of becoming CEO, date of leaving etc. Compustat gives unique identifiers for not only the firms, but also the induvial executives, making it possible for us to track the progress of a specific executive over time. This feature will become important for deciding if a CEO is fired or is leaving for some other reason, as we will explain later.

It is important to note that while Compustat shows when a CEO is changed in a firm, it does not always mention the reason. Therefore, it may not be helpful for deciding if a particular CEO change or turnover was forced or not. Furthermore, Compustat provides annual data only for CEO turnover.

In gathering data for CEO turnover, we only consider firms for which we have corresponding returns data in CRSP i.e. only those firms in CRSP for which we can find corresponding GV Keys. In effect, the firm GV Key from Compustat is the key to combining the returns data from CRSP with the CEO data from Compustat.

In addition, we also gather data on accounting variables, specifically book value of assets, for the firms using Compustat.

Appendix

1.1 Structuring of Monthly Data

We ignore any firm-year for which we have incomplete monthly data for total returns, month end closing prices and shares outstanding. We will use monthly returns and market capitalizations to calculate annualized returns and peer group portfolio returns, and this requires that we have data for all months for each year of the firm. There are several reasons for a firm to have missing monthly data in CRSP, including bankruptcy, suspension of trading of issue, removal of issue from the exchange etc.

Some firms have multiple equity issues on the market simultaneously. If a firm has multiple equity issues available in a given year, we select one issue based on the following criteria:

a. The issue that has the more observations available
b. In case of equal or similar number of observations, the issues that was issued first

Using these criteria, we ensure that we get as large a sample as possible to test. The reason to select an equity issue based on which was issued first is that most of the firms have only one issue in the market in the period tested, which would be their first issue. Hence, if the number of observations is identical or close to identical, we select the equity issued first to keep consistency with the single equity issue firms.

We remove any firms which are trading in non-US exchanges e.g. Canada. Furthermore, we remove any data related to issues that are not ordinary common shares e.g. American Depository Receipts (ADRs), ETFs, RIETs etc.

It is important to note that we obtain returns data from CRSP but the accounting and turnover data is based on Compustat. To combine the two databases, we cross reference the issue identifiers in CRSP with the firm identifiers in the Compustat database. Specifically, we use a combination of ticker symbols and firm identification number in CRSP (PERMCO) to identify the firm identification number in Compustat (GV Key). We only take data for those firms for which we have valid GV Keys in Compustat. Firms in CRSP for which an equivalent GV Key cannot be found in Compustat are excluded from our sample.

1.2 Calculation of Annual Return and Annual Market Capitalization

To calculate annual returns, monthly returns data (inclusive of dividends and adjusted for splits etc.) is taken from CRSP, along with monthly closing equity prices and the corresponding

number of shares outstanding for each issue. The returns are annualized based on the following equation:

$$Annual\ return\ (firm\ j) = e^{\sum_{t=1}^{12} \ln(1+\text{monthly return firm j}_t)} - 1$$

Therefore, we calculate the annual return for a firm for a given year as a geometric mean of the monthly total return on its stock in the year. The decision to take total, instead of capital, returns is to capture the effect of dividends and financial policy. Ignoring dividends would cause non-dividend paying firms to appear to be outperforming more mature, dividend paying firms and would distort the analysis.

Annual market capitalization is calculated as the average of monthly market capitalization from the month closing share prices and number of shares outstanding, as per the following equation:

$$MC_j = \left(\frac{1}{12}\right) \times \sum_{t=1}^{12} (Price\ j_t \times Shares\ j_t)$$

Here $Price\ j_t$ and $Shares\ j_t$ refer to the month-end share price and shares outstanding at month t for a firm j. Month-end share price is defined as the average of bid-ask prices of the stock on the month-end date. If such data is not available, we use the alternative price, defined as the last non-missing price available for the month.

We use the average of monthly market capitalizations instead of the capitalization at end of the year to prevent our results from being distorted due to changes in stock prices during the year. We observe existence of cases where there is a significant change in stock price between January and December in the sample. Using average monthly market capitalizations, each month contributes equally to the annual market capitalization, and prevents firms from having excessively high (low) market capitalization due to abnormally high (low) prices at year end.

1.3 Fama- French segments peer grouping

Fama-French industry classifications divide firms into different industry segments, based on their Standard Industrial Classification code. The Standard Industrial Classification (SIC) is a system for classifying industries by a four-digit code used in the US (Occupational Safety and Health Administration, 2007).

A key feature of the SIC codes is that they group firms according to the production processes they use, and not according to the products they offer to customers. The SIC codes are arranged in such a way that they can be grouped into larger categories e.g. industry grouping, major

grouping, division grouping. For this research, we limit ourselves to only the industry level grouping.

Based on the industry classification provided by Ken French, we classify the firms in our sample into the required industry segments. We consider all the firms in one industry to be peers of each other. When calculating the peer return for a firm X, we remove firm X from the peer returns calculation.

SIC is the "traditional" method of classifying firms into industry groups, but SIC classification has some major limitations. Hoberg and Philips mention four major drawbacks of classifications based on SIC codes. SIC classifications do not reclassify firms over time, so a firm may continue to be classified in one industry when it has branched into new markets and products over time. SIC codes are also difficult to use to classify new innovations and products as this classification was originally designed for 1970's businesses and is hard to use with modern technologies and products. Additionally, SIC based classification can cause issues where two firms who are not competitors themselves are both competitors of a third firm (so they must be competitors themselves, but the classification says otherwise). SIC based classification also does not provide continuous measures of similarity, either within or across industries (Hoberg & Phillips, 2018).

It should be noted that we explicitly remove the segments regarding utilities, banking and insurance. These segments often have industry dynamics very different from the other "normal" segments, due to different regulations and capital structures, and by excluding them we prevent these firms or segments from contaminating the rest of the sample.

1.4 Hoberg-Philips peer grouping

Hoberg-Phillips uses text analysis of financial statements of firms to classify them as similar to each other or not. Firms that are similar to each other tend to have the same product or business lines and are therefore considered to be competitors or peers. It is worth noting that while Fama-French segments use SIC codes to classify firms, Hoberg-Philips is based on text analysis and therefore, if a firm changes its line of business, Fama-French segments may not be updated as quickly as Hoberg-Philips since SIC codes are not updated as frequently, but text analysis of financial statements is done annually by Phillips and Hoberg. A full discussion of the methodology can be found in the paper by Hoberg and Philips (Hoberg & Phillips, 2009).

To create peers under Hoberg-Philips, we use data provided by the Hoberg-Philips data library (Holberg & Phillips, 2018). This library gives pair-wise cosine similarity scores for firms. Each

firm (represented by its GV Key) is paired with firms that are its peers or competitors based on the cosine similarity scores of their financial statements. The library only shows those firms that are peers for any given firm, hence there is no need to create arbitrary cut off values for cosine similarity.

We remove any GV Keys that we do not have returns data for and consider values for only the period 2005-2016. This method gives us a list of firms which are to be considered peers of a specific firm for each year. The Hoberg-Philips data library only gives data for the period 1996-2015. For 2016, we keep the 2015 peer grouping constant for each firm i.e. firms that are considered peers in 2015 are assumed to be peers in 2016 as well.

Hoberg-Phillips is more sophisticated and recent method for identifying peers and competitors of a firm, and as such it may considered more accurate than Fama-French. However, it has a few shortcomings. Since we remove any firm for which we do not have annual return data, we reduce the total number of firms we can use from the data library, and so reduce the peer group for each firm in the list. This is not a major issue for business in segments like Retail, where there are many firms in the industry. However, for segments with a smaller number of firms already, removing firms for which we do not have GV Keys (and therefore no returns data) causes the peer group to become very small. However, such cases are few and we believe that the impact of this methodology on our results is limited.

It should be noted that, just as we did for Fama-French segments, we explicitly remove the segments of utilities, banking and insurance.

1.5 Peer Group Return Calculation

For both Fama-French and Hoberg-Philips, we calculate market capitalization weighted peer group returns, as well as the equally weighted peer group return.

To calculate value weighted peer-group return for a given firm j, for a given year t, with annual return given as $R_{j,t}$, we start by excluding that firm itself from the group. For the remaining firms (given as $i \in (1,2,..n)$ but excluding j), we calculate market weighted return based on the following method:

$$\text{Market capitalization weighted return}_{j,t} = \frac{\sum_{i=1}^{n}(MC_i \times R_{i,t})}{\sum_{i=1}^{n} MC_i} \text{, where } i \neq j$$

To calculate equal weighted peer-group return for a firm, for a given year, we start by excluding that firm itself from the group. For the remaining firms (the "peers"), we calculate equal weighted return based on the following method:

$$\text{Equally weighted return}_{j,t} = \frac{1}{n} \ x \ \sum_{i=1}^{n} R_{i,t} , where \ i \ \neq \ j$$

The main difference between the two returns is that, in case of market capitalization weighted peer returns, the larger peers are given larger weights in the overall return calculation, while in equally weighted returns, each firm has equal weight in the overall return calculation.

We use these variables to split total return of a stock to an industry dependant portion (return due to the industry, which the CEO is not accountable for), and an idiosyncratic return (return due to other factors, including CEO skill).

1.6 Board Duration Dummy Variable Construction

Board duration for firms in our sample is an integer between 1 and 5. Appendix 4.1 shows the frequency distribution of board duration in our sample.

We see that most of the firms in the sample have durations between 1 and 3 years. To see the effect of abnormally larger board durations on misattribution, we define a dummy variable:

$$Duration_{i,t} = \begin{cases} 0, & BrdDur_{i,t} \leq 3 \\ 1, & BrdDur_{i,t} > 3 \end{cases}$$

Our purpose is to see the effect of higher than normal board duration on predicted misattribution. While we accept that the optimal or "normal" duration of a board will depend on firm and industry factors, the reason for setting the limit of "normal" duration at 3 is that we see that many firms have board durations of three years or less, but only a few have more than three.

If we define abnormal board duration as duration greater than or equal to 3 years, board duration becomes insignificant in our model. We feel that the reason for this is not that board duration does not matter, but because 3-year durations are the second most frequent value and results in the dummy variable taking value of 1 in almost 44% (3252 out of 7351) of the observations. This makes it hard to isolate the impact of larger board durations and makes it appear as board duration has no impact. However, if this were the case, we would expect to see

insignificant results using our original criteria (duration greater than 3) as well. This is not the case, suggesting that duration does indeed impact predicted misattribution.

1.7 CEO Tenure and CEO Ownership

In the prediction of CEO forced turnover, we control for CEO tenure. This is a control for CEO power and influence. Specifically, higher CEO tenure is associated with more influence. CEO tenure is calculated from the data provided in Compustat. Specifically, for each turnover event for all firms in the data, we look at the date when the CEO was removed and when he or she started as CEO (*not* when they joined the firm). This gives us the total tenure of the CEO in months, which is what we use.

To further control for the effect of CEO power, we check if the CEO has a high ownership in the firm. Compustat data provides details for the total shares outstanding of the firm in a given year. We cross-check this value with the value for shares outstanding shown by CRSP to ensure that it is correct. Compustat also provides the number of outstanding shares held by the executive officers of the firm (if any), including the CEO, for any year. CEO ownership is calculated as CEO shareholding as a percentage of total shares outstanding for a firm for a given year. It is important to note that we use values of shares outstanding adjusted for splits and bonus issues, as provided in Compustat.

We create a dummy variable for high CEO ownership for each firm for each year, defined as:

$$High\ Ownsership_{i,t} = \begin{cases} 0, & CEO\ Ownership_{i,t} < 5\% \\ 1, & CEO\ Ownership_{i,t} \geq 5\% \end{cases}$$

Appendix 4.2 provides a summary of the CEO ownership data in the sample. We see that while most CEO ownership is concentrated around 2% of total shares of the firm, there are some large outliers. The reason to use 5% ownership as a threshold value for the dummy is to see the impact of such large CEO ownership (which may indicate very entrenched CEOs) on the predicted misattribution.

1.8 CEO Turnover Classification Method Used

The classification system we use is based on the "performance induced" turnover findings (Jenter & Lewellen, 2017). The findings show a link between firm performance and CEO turnover and show that a large number of turnovers are performance induced i.e. many turnovers exist which would not have happened had the firm had good performance.

We classify turnover in any firm in any period as forced if *the firm underperforms its peers in the period prior to the turnover*. Turnover where the firm had previously out-performed its peers is classified as voluntary. Specifically, for a turnover in firm i in period t, we define a dummy variable for forced turnover, $Firing_{i,t}$, which is defined as:

$$Firing_{i,t} = \begin{cases} 0, & R_{i,t-1} \geq R_{p,t-1} \\ 1, & R_{i,t-1} < R_{p,t-1} \end{cases}$$

Here, $R_{i,t-1}$ is lagged period total return of the firm and $R_{p,t-1}$ is the lagged period return of peers.

We would argue that a turnover where the above criteria is met is more likely to be a forced turnover than a voluntary turnover. A firm would not forcibly remove or fire a high performing CEO who is delivering strong results. On the other hand, if the firm has underperformed its peers and then has a CEO turnover, it is likely that poor performance in the prior period played a role in the turnover. Even if the CEO is not fired directly, poor performance may be used to get the CEO to voluntarily leave or retire. In such a case, even though the turnover may appear voluntary, it is hard to argue that this was not a *de facto* firing.

It is important to point that this method is by no means perfect at classifying turnover. High performing CEOs with strong prior period results many still be fired due to scandal or criminal activities, yet our methodology would classify the turnover as voluntary. A CEO fired due to very poor results in the period of firing, regardless of prior period results, would be classified as voluntary under this system. On the other hand, a CEO who has planned to voluntarily retire may be classified as forced if the firm underperforms its peers for any reason.

1.9 Robustness Checks on Classification Method

We check the robustness of our classification criteria by comparing our results where the firm simply underperforms its peers (base case) with alternative criteria where the firm underperforms its peers by a specific level. Specifically, we compare:

- Base case: $R_{i,t-1} - R_{p,t-1} < 0\%$
- Alternative 1: $R_{i,t-1} - R_{p,t-1} \leq -1\%$
- Alternative 2: $R_{i,t-1} - R_{p,t-1} \leq -5\%$
- Alternative 3: $R_{i,t-1} - R_{p,t-1} \leq -10\%$
- Alternative 4: $R_{i,t-1} - R_{p,t-1} \leq -15\%$
- Alternative 5: $R_{i,t-1} - R_{p,t-1} \leq -20\%$

Table A.1 shows the results of our robustness tests. We see that changing the level of underperformance of the firm relative to its peers does not impact the direction of our findings. Indeed, increasing the level of underperformance increases both the impact and the significance of the coefficient for industry induced stock return on CEO turnover probability i.e. misattribution. The coefficient for idiosyncratic stock return CEO turnover probability also shows the same trend. We see that the results are highly significant in all cases. We conclude that our classification method is robust to changes in level of underperformance.

Another robustness checks we apply is to see if the CEOs whose turnovers we classify as forced appear again in our sample as CEOs of other firms. We apply new criteria that a turnover is forced only if the firm underperforms its peers in the previous period, and in addition, the CEO does not appear again in our sample as CEO of some other firm within 1 year. These criteria result in a stricter test for forced turnover. The reasoning is that if a CEO who underperforms relative to the firm's peer group but then finds a new job as CEO within one year, then the turnover is unlikely to be forced. This is because if the turnover is forced, then the CEO is unlikely to quickly find a new CEO position due to negative impact on reputation etc. However, if the CEO appears again within one year in the sample (after a turnover), it is more likely that the turnover was voluntary and not related to underperformance e.g. CEO may have taken a new job in another firm.

Table A.2 shows the results of our original criteria and the new criteria. We see that the new, more restrictive criteria give similar results as our original criteria, with the coefficient of industry-induced stock return showing only a small change. We conclude that our original criteria is robust to additional restrictions and is therefore a good predictor of whether a turnover was forced or not.

1.10 Comparison with Parrino and age-based turnover classification

A common method to classify turnovers is to use the Parrino algorithm (Parrino, 1997) or its variation. The Parrino algorithm classifies a turnover as forced or voluntary based on analysis of news articles regarding the turnover. If the news articles reveal a turnover as forced, it is automatically assumed to be so. Otherwise, the classification is based on CEO characteristics like CEO age and CEO tenure. Under this algorithm, a turnover occurring when the CEO is near retirement age is a voluntary turnover as (it is assumed) that the CEO has retired. While this method has theoretical merit, a key issue is that it ignores performance of the CEO. Research shows that poor performance increases turnover probability, even in CEOs who are

in retirement age (Jenter & Lewellen, 2017). Additionally, this method is sensitive to the retirement age used and changing the retirement age criteria will greatly change the classification of turnovers. Therefore, the Parrino algorithm is prone to false negatives i.e. turnover is forced but classified as voluntary.

We test if an algorithm similar to Parrino can be used in our analysis. We start by searching news articles and online content for information on CEO firings. Our search showed that, with a few exceptions, most turnovers were rather vaguely reported online. The result is that it is hard, in most cases, to judge if the turnover is forced or not.

We then apply age-based criteria, with a turnover assumed to be forced only if the CEO is under 65 at the time, and test for misattribution using the classification using the age-based criteria. The results are presented in Table A.3. We see that the age-based criteria show there is no misattribution, as industry-induced stock return is insignificant in all methodologies. The reason for this is that most of the CEOs in our sample are in the range of 58-68 years. Applying an arbitrary cut-off age of between 60-65 years as the criteria results in very different classifications of the turnovers. If the cut-off age is set to 60, most turnovers become voluntary. If its 65, most turnovers become forced. In addition, many CEOs do not have their age reported. We therefore conclude that Parrino and similar age-based criteria are very subjective and unreliable for the purposes of classifying turnovers in our sample. We therefore prefer our criteria.

Table A.1: Testing Robustness of Classification Method to Levels of Underperformance

This table shows the results of the regression of predicted peer-induced returns on firm's total return for various levels of underperformance. The classification system used categorizes turnovers as forced if the firm underperforms its peers in the prior period. To test the robustness of the classification system, summarized results for the regression of predicted peer-induced returns on firm's total return are shown, where restrictions are placed on by how much the firm must underperform to categorize its turnover as forced. Getting consistent results shows that the classification method is robust to level of performance. For each level of underperformance, the number of observations for both the number of forced turnovers and the firms for which governance data is available are given.

Base case is our original method (turnover is forced if lagged firm return is lower than lagged peer return). Column named 1% is results when turnover is forced if lagged firm return is lower than lagged peer return by at least 1%. Column named 5% results when turnover is forced if lagged firm return is lower than lagged peer return by at least 5%. Similar interpretations apply for the Column named 10%, 15% and 20%.

The regression equation is given as:

$$R_{i,t-1} = b_0 + b_1 R_{p,t-1} + \alpha_i + e_{i,t-1}$$

Where $R_{i,t-1}$ is the lagged total return of the firm, $R_{p,t-1}$ is the lagged peer return, $e_{i,t-1}$ is the corresponding error term and α_i is the fixed effect. Peer groups here are for Fama-French (FF) value-weighted only, but comparable results are found for the other peer return methods as well. The z-statistics in the brackets below are all calculated using robust standard errors, clustered at the industry level. Time fixed effects are also controlled for. ** and *** denote significance at the 5% and 1% level, respectively. R-squared values are unavailable for Probit regressions.

	Base Case	1%	5%	10%	15%	20%
Industry-induced stock return in year $t-1$	-0.659***	-0.666***	-0.691***	-0.830***	-1.005***	-1.133***
	(-5.40)	(-5.41)	(-5.55)	(-6.38)	(-7.23)	(-7.67)
Idiosyncratic stock return in year $t-1$	-1.217***	-1.245***	-1.334***	-1.508***	-1.720***	-1.885***
	(-11.95)	(-12.05)	(-12.37)	(-12.94)	(-13.24)	(-13.18)
Number of Firings – Accounting & Ret	304	296	273	236	193	157
% of firings retained	100 %	97 %	89 %	77 %	63 %	51 %
Number of Firings - Governance	132	124	112	95	76	58
% of firings retained	43 %	41 %	37 %	31 %	25 %	19 %

Table A.2: Regression of Peer-induced Return on Total Return -New Job Restriction

This table shows the result of regressing predicted peer-induced returns and idiosyncratic returns on CEO Forced Turnover using a probit model. The method to classify turnovers as forced or voluntary is modified-a turnover will be forced only if the firm underperforms its peers in the previous period and, in addition, the fired executive does not appear as CEO of some other firm in the sample within a period of 1 year. It may be possible for a underperforming CEO to voluntarily resign and get a new job in another firm as CEO. This is a voluntary turnover but would classified as forced.

The model is controlled for fixed effects and given as:

$$\text{p}(\text{TO}_{i,t}) = \alpha_o + \alpha_1 \hat{R}_{i,t-1} + \alpha_2 \hat{e}_{i,t-1} + \alpha_3 Tenure_{i,t} + \alpha_4 Own_{i,t} + \alpha_5 Retire_{i,t} + \varepsilon_{i,t}$$

Results shown here are for Fama-French (FF) value-weighted only, but comparable results are found for the other peer return methods as well. The z-statistics in the brackets below are all calculated using robust standard errors, clustered at the industry level. A CEO has a high equity ownership if she owns more than 5% of the issued shares. She is of retirement age if in the age group of 63-66 years. Time fixed effects are also controlled for. ** and *** denote significance at the 5% and 1% level, respectively.

	(Not considered) Forced CEO Turnover	(New job) Forced CEO Turnover
Industry-induced stock return in year $t-1$	-0.659***	-.652***
	(-5.40)	(-5.32)
Idiosyncratic stock return in year $t-1$	-1.217***	-1.212***
	(-11.95)	(-11.86)
CEO with high equity ownership	-0.567***	-.567***
	(-4.41)	(-4.56)
CEO tenure in years	0.00752	0.00779*
	(1.90)	(1.97)
CEO of retirement age	0.354***	0.356***
	(4.83)	(4.87)
Constant	-2.236***	-2.239***
	(-15.58)	(-15.36)
Observations	8879	8879

Table A.3: Regression of Peer-Induced returns on Total Return - Age-based Criteria

This table shows the results of regressing peer-induced returns on total return of a firm, using an age-based criterion to classify turnovers as forced or voluntary. A turnover is forced if the CEO being let go is under 60 years of age, and voluntary if she is above 60 years of age.

The model is controlled for fixed effects and given as:

$$p(\text{TO}_{i,t}) = \alpha_o + \alpha_1 \hat{R}_{i,t-1} + \alpha_2 \hat{e}_{i,t-1} + \alpha_3 Tenure_{i,t} + \alpha_4 Own_{i,t} + \alpha_5 Retire_{i,t} + \varepsilon_{i,t}$$

The probabilities are calculated using the predicted stock returns and residuals from Table 2. The predicted stock returns are peer-induced returns and residuals represent idiosyncratic returns. Peer groups made from both Fama-French (FF) and Hoberg-Philips (HP) grouping, for both value-weighted and equally-weighted peer groups. A CEO has a high equity ownership if she owns more than 5% of the issued shares. She is of retirement age if in the age group of 63-66 years. The z-statistics in the brackets below are all calculated using robust standard errors, clustered at the industry level. Time fixed effects are also controlled for. ** and *** denote significance at the 5% and 1% level, respectively. R-squared values are unavailable for Probit regressions.

	VW Industry		EW Industry	
	(FF) Forced CEO Turnover	*(HP)* Forced CEO Turnover	*(FF)* Forced CEO Turnover	*(HP)* Forced CEO Turnover
Industry-induced stock return in year $_{t-1}$	-0.0655	-0.129	-0.0835	-0.117
	(-0.57)	(-1.01)	(-0.68)	(-0.95)
Idiosyncratic stock return in year $_{t-1}$	-0.314***	-0.303***	-0.318***	-0.316***
	(-4.38)	(-4.05)	(-4.32)	(-4.10)
CEO with high equity ownership	-0.716***	-0.706***	-0.718***	-0.706***
	(-4.86)	(-4.70)	(-4.86)	(-4.70)
CEO tenure in years	-0.00562	-0.00521	-0.00556	-0.00517
	(-1.26)	(-1.14)	(-1.25)	(-1.13)
CEO of retirement age	0.316***	0.313***	0.317***	0.313***
	(4.36)	(4.18)	(4.37)	(4.18)
Constant	-1.991***	-2.022***	-1.991***	-2.025***
	(-13.84)	(-13.43)	(-13.82)	(-13.42)
Observations	8879	8445	8879	8445

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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