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Does board turnover matter in competitive industries?  
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The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

## **Abstract**

This thesis studies how the magnitude of board turnover effects the subsequent firm performance. By analysing firm-year data concerning board and firm characteristics this effect is estimated. The focus of this paper is on the effect which industry competitiveness has on the main relationship. Moreover, different moderators regarding the information processing capacity of the boards are tested. The results show that there is negative main effect between board turnover and subsequent firm performance. However, industry competitiveness and all other tested interaction effects are found to not moderate this relationship. Besides the negative main effect, this research does not find more evidence for the effect depending on the information processing ability of the board nor does it find evidence for the importance of board turnover being dependent on industry competitiveness.

# 1 Introduction

Boards of directors are a fundamental pillar of corporate governance and the subject has received considerable academic attention over the years. However, the question remains whether the composition and turnover of these boards influences the performance of the firms and executives they govern. In a working paper, Jenter et al. (2023) find evidence that an obliged increase in board size is negatively associated with firm performance. Regarding board turnover - which refers to changes in board membership through the arrival or departure of formally designated members - most research up until now has focused on the causes of board turnover (Arthaud-Day et al., 2006; Hillman et al., 2000; Marcel & Cowen, 2014; McDonnell & Cobb, 2020). However, little research has yet been done on the effect which board turnover has on firm performance. In a descriptive study Anderson and Chun (2014) find that there is a sweet spot in board turnover of 3–4 replacements in a three-year period. However, Liu et al. (2013) find a negative relationship between board turnover and firm performance using Taiwanese data.

A recent study by Qiang et al. (2022) has shed more light on the impact of board turnover. Qiang et al. (2022) have researched the impact of board turnover on future firm performance from an information processing perspective, using a longitudinal analysis of 3890 publicly listed U.S. firms over a 12-year period. The study finds that a higher magnitude of board turnover is negatively associated with subsequent firm performance, but this negative impact is mitigated when the board has higher pre-turnover information elaboration ability. The replication of Qiang et al. (2022) will be at the core of this thesis.

In addition to the core, an extension will be researched in this thesis. Giroud and Mueller (2010) have researched the impact of business combination (BC) laws on corporate governance and managerial behaviors in different industry settings. The study finds that BC laws weaken corporate governance and increase managerial slack, particularly in non-competitive industries, leading to adverse effects on operating performance and stock prices. The authors conclude that corporate governance measures matter more in non-competitive industries. With this conclusion in mind, it raises the question whether the magnitude of board turnover has a larger effect on firms in non-competitive industries. Board of directors have the function of aligning the incentives of executives with the incentives of shareholders. Giroud and Mueller (2010) argue that their result show that this gap in incentives between the principal and the agent gets smaller with industry competitiveness. With industry competition being the factor which steers executives towards incentives closer to those of the shareholders. So, following this rationale, a board which oversees the executives of a firm in a more competitive industry is of less importance than a board which oversees the executives of a firm in a less competitive industry.

This thesis aims to provide further clarification into the relationship between board turnover and firm performance. By using a measure of industry competition in the analysis, light will be shed on the yet unknown influence of competition on the the relationship between board turnover and firm performance. Giroud and Mueller (2010) measure competition based on the Herfindahl-Hirschman index (HHI), which is calculated using firm-level data from Standard & Poor's Compustat. The HHI is a well-established measure in industrial organisation theory and is commonly used to assess market concentration and competition within an industry.

Given that Giroud and Mueller (2010) find that industry competition reduces the importance of corporate governance, it is reasonable to assume that competition also reduces the importance of the board. Therefore, it is plausible that the influence of board turnover is reduced by competitive industries, regardless of whether this relationship is positive or negative. Thus, the research question of this thesis is as follows: 'How does board turnover effect firm performance, and does the impact differ between competitive and non-competitive industries?'

To answer the research question, an OLS regression analysis is performed on secondary data collected from various data sources. The data sources are BoardEx, Compustat and Thomson Reuters (13f filings). Boardex is an extensive database which provides detailed insights into the demographic composition of boards, tenure of board members, meeting frequency, job-related diversity, and CEO power relative to the board. Based on the data from BoardEx, an aggregation is made from which board turnover per firm and other board characteristics are computed. The firm-year observations from Boardex are merged with firm-year observations from Compustat. Compustat is a comprehensive database of financial, statistical, and market information about publicly traded companies. From Compustat, data regarding the firm performance and the industry is collected. Industry codes and sales data are used to compute the HHI. Moreover, data regarding institutional ownership is collected from Thomson Reuters (13f filings).

The regression model has Return On Assets (ROA) as dependent variable and the independent variable of interest is board turnover. Interaction terms are created to test for moderating effects, specifically for the moderating effect of industry competitiveness. Moreover, similar categories to Anderson and Chun (2014) are used in an alternative regression to check whether it is possible that moderate turnover is ideal.

My hypothesis is that there is an overall negative effect of board turnover and that the information processing perspective will be substantiated by the significance of relevant moderators, as Qiang et al. (2022) have found. However, I also expect these findings to be more extreme for non-competitive industries than for competitive industries which seems like a logical extension of Giroud and Mueller (2010). Moreover, it is reasonable to think that a categorical approach finds that moderate turnover is ideal, similar to Anderson and Chun (2014). Their results are intuitively not surprising, however do stand in contrast to Qiang et al. (2022). Anderson and Chun (2014) find that firms with no board turnover over a four year period perform very poorly, followed by firms with the highest amount of turnover. The best performing firms are those with a moderate amount of turnover, followed by firms with a low amount of turnover. Since the study of Anderson and Chun (2014) has different measurement points and is very comprehensive compared to Qiang et al. (2022) it is hard to combine their results into a common understanding at the moment. This research aims to combine these hypotheses which will add to the understanding of board turnover and maybe give directions for future research.

The remainder of this thesis is structured as follows: First, the key concepts of this thesis will be discussed in relation to the academic literature surrounding them in Section 2. Next, the data used in this thesis will be discussed in Section 3. Following, the methodology used to analyse this data is discussed in Section 4. The results derived from the methodology will be presented and described in Section 5. Finally, the results will be discussed in Section 6, conclusions will be drawn in Section 7 and the limitations of this paper will be adressed in

## 2 Theoretical Framework

This Section discusses the predictor and the outcome of this thesis and the relationship between the two. First, the measurement of firm performance is explained and discussed. Second, the definition of board turnover is discussed and the information processing perspective of boards is explained. Third, the relationship between the two concepts is discussed as it is currently understood in the academic literature. Finally, industry competition is discussed and its role as a moderator is explained.

### 2.1 Firm performance

As this thesis aims to replicate the study by Qiang et al. (2022), the same measure of firm performance is used. The measure used as a proxy for firm performance is return on assets (ROA), which is common in corporate finance academic literature (Arthaud-Day et al., 2006; Carter et al., 2010; Erhardt et al., 2003). ROA provides information on how much profit a company's assets are generating on average. As such, ROA is a valuable measure of a company's operational efficiency and therefore a good indicator of a company's performance (Petersen & Schoeman, 2008). However, criticism also exists for the measure. Damodaran (2007) points out two problems when after-tax operating income is divided by the book value of total assets: First, ROA yields a value higher than the capital invested in the return on capital computation, leading to comparability issues. Second, ROA cannot be compared to the cost of capital, as it does not incorporate the costs of debt and equity invested in assets. However, this argument does not seem to prevail for most researchers, given the popularity of ROA as a measure for firm performance. Qiang et al. (2022) do make the ROA variable more robust, by median-adjusting it they aim to remove the industry-level effects and focus on the firm's performance relative to its industry peers. This adjustment allows for a more precise evaluation of the firm's performance and facilitates comparisons across different firms operating within the same industry. Additionally, industry median-adjusted ROA provides a standardized measure that enables them to analyze the impact of board turnover on firm performance in a more controlled and industry-specific context.

### 2.2 Board turnover

Board turnover refers to changes in the composition of the board due to the arrival or departure of formally appointed members of the Board (Qiang et al., 2022). Board turnover can occur for many reasons. Board directors are more likely to leave companies if there is no ideological alignment and directors can also leave as a result of a boycott of the company (McDonnell & Cobb, 2020). A more common perspective on board turnover is that it often follows poor firm performance or financial distress (Arthaud-Day et al., 2006; Marcel & Cowen, 2014). Moreover, board members may leave the board voluntarily or involuntarily. Regarding unforced board changes, Ewelt-Knauer et al. (2024) find that reputational, financial, risk and workload incent-

ives influence independent directors' decisions to join new boards or leave existing ones.

Although the above studies consider board turnover as the outcome and in this thesis board turnover will be the predictor, the measure is similar. In Section 4, the construction of the variable board turnover will be discussed in detail.

## **2.3 The relationship between firm performance and board turnover**

### **2.3.1 Agency theory perspective**

At the foundation of corporate governance, one will surely find agency theory (Fama & Jensen, 1983). The premises of agency theory show that board independence is an important aspect of creating a successful principal-agent relationship which shall result in optimal firm performance. An important concept regarding the agency theory perspective is the 'captured' board: When board members are no longer effectively representing the shareholders but are instead responsive to the leading officers of the corporation (Kastiel & Nili, 2017). The turnover of board members can be seen as a precaution to the board being captured, since tenure of board members increases the chance of a CEO becoming chairman of the board (Graham et al., 2020). Therefore, given that board turnover results in more board independence, a positive relationship is to be expected between board turnover and firm performance when one views the relationship from the agency theory perspective.

### **2.3.2 Information processing perspective**

Qiang et al. (2022) base their hypotheses mainly on the information processing perspective on board turnover. Their rationale is as follows: A boards' effectiveness relies heavily on its information processing ability. Higher board turnover is expected to disrupt the information elaboration process since increased turnover in small groups is associated with less team learning, less cooperative behaviour and less capacity for open discussion (Heavey et al., 2013). This rationale will be further explained and substantiated in the rest of this section.

Boivie et al. (2016) shed light onto the importance of information processing for boards in effectively monitoring management. The authors argue that to fulfill this monitoring role, directors must be able to acquire, process, and share information. Moreover, Khanna et al. (2014) find that firm performance is likely to benefit from directors' human capital, prior experience and education, as this makes them more effective at monitoring management and providing advice. In addition, Khanna et al. (2014) suggest that the benefit of directors' human capital depends on the information processing load imposed on them by their other board positions, which may limit the beneficial effects of their general human capital.

Research in small groups in social psychology and management disciplines has shown that turnover tends to disrupt information processing and group performance (Heavey et al., 2013; Li & van Knippenberg, 2021). However, it is also important to note that Li and van Knippenberg (2021) find that over time, as teams adapt to form new shared processes and states, positive performance effects gradually emerge.

An important part of information processing in this context is information elaboration within the board - the act of sharing and integrating information to ensure effective decision

making. Groups such as boards of directors develop an information elaboration capacity over time, characterised by increased familiarity, social integration and shared cognition among board members (Maynard et al., 2019). This enhanced information elaboration capacity facilitates the efficient exchange and use of information among directors. More specifically, boards of directors develop shared cognition in the form of a 'transactive memory system' (Lewis, 2004). Regarding the transactive memory system, Heavey and Simsek (2017) conclude that CEOs must navigate the tension between maintaining continuity by retaining experienced members and infusing the team with fresh perspectives and new insights. Achieving this balance is essential to creating a dynamic and adaptive cognitive structure within the team that enables the integration of established knowledge with innovative thinking. Argote et al. (2018) show that an important distinction can be made between groups with respect to transactive memory systems. While fully connected groups excel when group membership remains stable, perfectly centralised communication networks allow easy integration of new members. A board of directors can be identified as a fully connected group, therefore Argote et al. (2018) provide an argument for the degeneration of the transactive memory system due to board turnover.

Overall, the information processing perspective outlined by Qiang et al. (2022) highlights the importance of information management within the board and the potentially disruptive impact of turnover on the board's information processing ability and subsequent firm performance. It is important to note, however, that some of the authors who argue for the potential negative effects of group turnover nuance this finding by stating that the effect of group turnover is conditional (Heavey & Simsek, 2017; Argote et al., 2018).

### **2.3.3 Informational capture of the board**

The agency theory perspective and information theory perspective provide two different angles for looking at the relationship between board turnover and firm performance. However, there also seems to be an angle which incorporates both views. Kastiel and Nili (2017) describe how boards can suffer from an 'informational capture' where non-executive directors, who work part-time and serve on multiple boards, face challenges in obtaining and analysing the extensive and complex information that modern boards must evaluate. They lack the time, resources and industry expertise to do this effectively. As a result, they are overly reliant on the information that management provides or conceals, and the way in which it is presented to the board. This reduces the board's ability to fulfil its monitoring role effectively.

The informational board capture perspective aligns with the information processing perspective but also provides a new view of the agency theory perspective. Whereas the 'traditional' board capture might be caused by a lack of turnover, the informational board capture can be caused by an abundance of board turnover. Given the complexity of the modern firm, the informational board capture seems intuitively more likely in current days. Therefore the following is expected regarding the main effect:

Hypothesis 1: *There exists an overall negative relationship between board turnover and firm performance.*

However, given Anderson and Chun (2014)'s concise study regarding board turnover, it is also expected that there is a 'sweet spot' in board turnover which should be moderate level.

Hypothesis 2: *Moderate board turnover is optimal for firm performance, meaning that the relationship between board turnover and firm performance is not linear.*

## 2.4 Competitive vs non-competitive industries

With agency theory already being mentioned as a crucial component of corporate governance, one could also state that the 'quiet life' hypothesis is a fundamental pillar of agency theory (Hicks, 1935). The 'quiet life' hypothesis states that managers in non-competitive industries may not be motivated to maximise the firm's profits and may instead choose to enjoy the 'quiet life', where difficult decisions are not taken and hard tasks are avoided by managers. A recent study has found solid empirical evidence for this hypothesis (Ikeda et al., 2017). On the other hand, Scherer (1980) describes the opposed situation, where perfect competition annihilates the 'quiet life' preferences of managers due to the fierce struggle for non-negative profits.

Given that that the above hypotheses are true, this means that industry competition will decrease managerial slack, something which Giroud and Mueller (2010) took upon themselves to empirically research. Their findings indicate a significant difference in the influence of corporate governance between firms in competitive and non-competitive industries. Supporting this, Chou et al. (2011) find that firms operating in competitive industries often exhibit inadequate corporate governance frameworks and the influence of corporate governance on performance becomes significant only in non-competitive industries. Evidence from Europe shows that corporate governance significantly increases firm value only in non-competitive industries and thus also underlines the difference between firms in competitive and non-competitive industries (Ammann et al., 2013). However, using Chinese data Yu et al. (2017) find that good corporate governance increases firm performance across all industries since it limits empire building. The results are strongest for state-owned firms, which might also explain the deviation from results derived from US and European data.

Giroud and Mueller (2010) use the Herfindahl-Hirschman Index (HHI) based on the three digit standard industry classification (SIC) as the main measure for competition but also test other competition measures and derive similar results. This paper will also use three digit SIC codes to create a HHI to measure competition.

Given the results of the above papers, it is expected that competitiveness will increase the pressure on managers to perform optimally and in the interest of the company. Taking this argument further, this implies that the importance of adequate corporate governance is reduced by competitiveness. Given that boards of directors are a fundamental part of the corporate governance structure of most companies, the importance of boards of directors is also expected to be reduced. Therefore, the third hypothesis of this thesis is as follows:

Hypothesis 3: *Firms in competitive industries demonstrate a weaker relationship between board turnover and subsequent firm performance*

## 2.5 Other moderators

Qiang et al. (2022) apply four interaction effects in their regression model to test for moderating roles between the relationship of board turnover and firm performance. Three of these four moderators will also be applied in this paper, namely: pre-turnover board diversity, pre-turnover CEO power and pre-turnover board tenure. Their theoretical basis for these variables again comes back to the information processing perspective of board turnover. They assert that the capability to process information pre-turnover reduces the effect which board turnover has on firm performance and they view these variables as proxies for this capability. Therefore, they argue that these variables will moderate the relationship between board turnover and firm performance.

### 2.5.1 Pre-turnover board diversity

Board diversity, measured pre-turnover, will be utilised to check for a moderating effect between board turnover and firm performance. Qiang et al. (2022) argue that board diversity in general does not show a concise relationship with information processing capabilities. However, when diversity is split into demographic diversity and job-related diversity, there is usefulness in the measure. Professional diversity in education and experience expands a group's knowledge and ideas, creating task conflicts that enable higher quality decisions and group performance (Bernile et al., 2018; Miller & del Carmen Triana, 2009; Pelled et al., 1999).

Therefore, professional diversity is expected to have a moderating effect on the relationship between board turnover and firm performance. This leads to the following hypothesis:

Hypothesis 4: *Firms with more job-related board diversity before the board turnover demonstrate a weaker relationship between board turnover and subsequent firm performance.*

### 2.5.2 Pre-turnover CEO power

The measure of CEO power will be used to check for a moderating role in the main relationship of the regression. Governance weakens when CEO power increases due to the CEO achieving seniority or board chairmanship (Finkelstein & D'Aveni, 1994; Sauerwald et al., 2016; Westphal & Zajac, 1995). The measure for CEO power should contain indicators which reflect the likelihood of the board being captured. Qiang et al. (2022) describe two ways in which a board can be captured. It can either be by the CEO selecting board members who are accommodating to his views (Sauerwald et al., 2016) or by the power of the CEO leading to norms of deference within the board (Westphal & Zajac, 1995). With regards to the information processing perspective, Qiang et al. (2022) argue that boards operating under a powerful CEO are less inclined to openly share and discuss diverse viewpoint. This leads to board members not familiarizing with each other's expertise and therefore not using each other's strengths optimally. This, in turn, reduces their ability to adapt to knowledge gaps left by departing directors. Furthermore, these boards are less effective at integrating new or challenging perspectives from incoming directors due to the established norm of deference.

With the above in mind, it is expected that the measure for pre-turnover CEO power will

lead to a moderating role between the relationship of board turnover and firm performance. Which leads to the following hypothesis:

Hypothesis 5: *Firms who's CEO has less power before the board turnover demonstrate a weaker relationship between board turnover and subsequent firm performance.*

### 2.5.3 Pre-turnover board tenure

In the research field surrounding group performance, there is consensus about the fact that group tenure leads to social integration and better group interactions (Katz, 1982). However Katz (1982) also finds that familiarity which is too strong within groups can lead to a reduction of communications in the group. This effect would then hamper the innovative and reflective capability of boards of directors. Huang and Hilary (2018) empirically verify this concave curvilinear relationship which board of directors have with board tenure. However, Qiang et al. (2022) find no evidence for this concave relationship in their research. A high level of board tenure does not show a significantly different firm performance from a moderate level of board tenure. The lower level of board tenure does show a significant negative effect.

Therefore, the expectation is that in this paper a general negative interaction effect will be found for board tenure and board turnover. Meaning that the the effect of board turnover on subsequent firm performance will decrease with the level of board tenure. This leads to the following hypothesis:

Hypothesis 6: *Firms who's board is more tenured before the board turnover demonstrate a weaker relationship between board turnover and subsequent firm performance.*

## 3 Data

### 3.1 Sample selection

From BoardEx, a dataset is obtained with director-year observations for North American directors for the period 2000-2020. This data set consists out of 139,883 unique directors/executives/managers spread over 16,074 unique firms. After constructing all necessary variables on director level, the data is aggregated to firm-year observations. Next, a Compustat dataset is merged which contains the necessary firm-level financial data. Lastly, a Thomson Reuters (13f filings) dataset is merged upon the main file to add institutional ownership data. This paper excludes the financial services (SIC: 6000-6999) and utilities (SIC: 4900-4999) industries as these are regulated industries.

Observations are excluded for a number of reasons. First, some variables are measured at  $t-3$  and firm performance is measured three years into the future, which in this research means  $2003 \leq t \leq 2017$ .

The dataset starts with 1,200,812 observations. Then, 190,499 director-year observations are deleted because they are neither a CEO nor a board member and 175,590 director-year observations are deleted because they operate in the excluded sic codes. A further 101,568 observations are dropped because they are duplicates and 305,116 observations are dropped

because they have a missing value for ROA. The dataset is then aggregated to firm year observations, which reduces the number of observations from 428,039 to 54,024. Duplicates are removed again, resulting in the removal of 1,499 observations. Furthermore, 18,434 observations are deleted because they lack control variables. In addition, 11,393 observations are dropped because they have a missing value for the main dependent variable ROA\_M\_1-3 and 14 observations are dropped because they have a missing value for board turnover. Finally, 6,037 observations are dropped for missing at least one of the three ownership variables (institutional, blockholder or board ownership) and then 1,443 observations are deleted because the ownership variables exceed 100%. The latter is an error in the data provision of Thomson Reuters, Compustat and/or BoardEx.

The final dataset consists of 15,406 firm-year observations for 2,456 different North American firms, of which 14,345 are observations of listed companies and 1,061 observations are of companies considered to be private.

## 3.2 Variables

### 3.2.1 Firm Performance (roa)

Following Qiang et al. (2022) ROA is measured using industry median-adjusted return on assets, where industry is classified using a 2-digit sic code. Adjusting ROA by the industry median allows for a more meaningful comparison among companies operating within the same industry. It normalizes for industry-specific factors and provides a clearer picture of a company's relative performance. By doing this, benchmarking against peers in the same industry becomes more meaningful. Using this median-adjusted ROA, the final measure of firm performance is constructed by using the average of industry median-adjusted ROA over three years.

$$ROA_{it}^{adj} = ROA_{it} - ROA_{jt}^{median} \quad (1)$$

where  $ROA_{it}$  is the return on assets for firm  $i$  in year  $t$ ,  $ROA_{jt}^{median}$  is the median return on assets for industry  $j$  (classified by the 2-digit SIC code) in year  $t$ .

The final measure of firm performance, using the average of industry median-adjusted ROA over three years, is calculated as:

$$ROA\_M_{1-3} = \frac{1}{3} \sum_{t=t_1}^{t_3} ROA_{it}^{adj} \quad (2)$$

By doing so, year specific firm performance is smoothed out (Shen & Cannella, 2002).

An alternative to using an industry median-adjusted version of ROA, would be to use industry fixed effects. Qiang et al. (2022) claim to do this for all regressions, however, the industry median-adjusted version of ROA should not be used together with industry fixed effects as it raises multicollinearity issues. Industry fixed effects are a good way to isolate the impact of industry-specific factors from other influences on performance. Therefore, as a sensitivity analysis, this paper tests regressions with industry fixed effects where the dependent variable is an unadjusted three-year average (ROA\_1.3), calculated in the same way as equation

(2).

### 3.2.2 Magnitude of board turnover (boardturnover)

An incoming director is identified by a tenure of less than 1.0 years according to BoardEx at the end of the year. Based on the total number of directors in the current year, the previous year and the number of new directors, the number of outgoing directors is calculated. According to Qiang et al. (2022), it is not necessarily important whether the coming and going of directors is voluntary or not. They argue that this distinction is not very relevant when the relationship is viewed from an information processing perspective. Moreover, it is a very difficult - and not always binary - distinction to make between voluntary and involuntary departure.

Magnitude of board turnover is measured by using a moving 3-year window, which is in line with prior research into top management turnover (Boivie et al., 2012; Wiersema & Bantel, 1993). Anderson and Chun (2014) only view one time period and take board turnover as a static occurrence in this period. However, a moving window allows to better capture trends over time, compared to a static variable. A moving window reduces noise from yearly fluctuations and improves reliability and robustness. A moving window does bring a bit more complexity in the model and reduces the ability to gain insights from specific events in time. But given the aim of this research, this does not form a problem. Therefore, the choice is made to also use a moving window for board turnover as it suits this research best.

The magnitude of board turnover is measured as follows:

$$\text{boardturnover} = \frac{\text{In}_{t-2} + \text{In}_{t-1} + \text{In}_t + \text{Out}_{t-2} + \text{Out}_{t-1} + \text{Out}_t}{\text{Board Size}_{t-2}} \quad (3)$$

### 3.2.3 Pre-turnover board job-related diversity (pt\_boarddiversity)

Qiang et al. (2022) use a four tier variable to measure board job-related diversity. They compute the diversity measure by taking into account (1) education level, (2) functional expertise, (3) industry experience, and (4) top executive experience. For this paper, this variable has been replicated without using functional experience due to the unavailability of data. The educational level of the directors is classified into one of four categories according to the highest degree obtained: PhD, Master's degree, Bachelor's degree or other. Industry experience is categorised by classifying directors according to the industry in which they have the most experience. While Qiang et al. (2022) classified industries using the Industry Classification Benchmark, this paper uses Fama & French's 12-industry classification (Fama & French, 1997). Directors who have ever been CEO of a company present in the BoardEx database are coded 1, otherwise 0. Qiang et al. (2022) restrict the last variable by adding the requirement that the company is an S&P 500 company. The diversity scores are Blau (1977) index scores of the three variables.

The Blau index is a measure of diversity, defined as:

$$B = 1 - \sum_{i=1}^n p_i^2 \quad (4)$$

where  $n$  is the number of categories and  $p_i$  is the proportion of the population in the  $i$ -th

category. The three scores are standardized and summed up to create the `pt_boarddiversity` measure.

### **3.2.4 Pre-turnover CEO power relative to board (`pt_ceopower`)**

The relative power of the CEO is quantified by looking at four indicators: (1) CEO duality, (2) CEO ownership, (3) relative tenure of the CEO compared to that of the board and (4) the amount of non-independent directors on the board. Qiang et al. (2022) base this choice of indicators on extensive and relevant prior literature on the topic of measuring executive power. CEO duality is arguably the most formal and direct form of measuring a CEO's power over the board. The distinction is made on the basis of the role description provided by BoardEx, directors who are both CEO and chairman of the board are coded 1, otherwise 0. CEO ownership is also a formal, albeit more indirect, form of power over the board. CEO ownership is calculated by dividing the value of the total shares held by the CEO in the company at the end of the year, as reported by BoardEx, by the market capitalisation at the end of the year. Market capitalisation is calculated by multiplying the number of shares outstanding by the share price at the end of the year, as reported by Thomson Reuters (13F).

Measures of informal CEO power are the relative tenure of the CEO and the number of non-independent directors on the board. Relative tenure is measured by dividing the number of years the CEO has been in his position by the average tenure of all directors. The number of non-independent directors is measured using the Non-Independent Director (NED) indicator provided by BoardEx.

The values of all these four indicators are standardised and then summed up to form the variable `ceopower`. In order to obtain pre-turnover ( $t-3$ ) values, a lagged value of `ceopower` is created, resulting in the final variable `pt_ceopower`.

### **3.2.5 Pre-turnover board tenure**

For every firm-year observation, the average tenure is calculated based on the tenure of directors as reported by BoardEx.

The tenure of the board is also divided into terciles, where the middle tercile serves as the benchmark group in the regression model. To check whether the unmatched expectations of Qiang et al. (2022) are also not matched in this sample, the variables `pt_boardtenure_lt` and `pt_boardtenure_ht` are created. They return the value 1 if the board tenure is in the lower tercile or higher tercile respectively.

### **3.2.6 Industry competitiveness (HHI)**

In line with Giroud and Mueller (2010), industry competitiveness will be measured based on the Hirfindahl-Hirschman index. The HHI is calculated with the full database of Compustat. To calculate the HHI, sales are aggregated per industry, where industries are separated by the 3-digit SIC code. The market share of a firm is defined as its yearly sales divided by the total

industry sales in that year. The HHI is calculated as follows:

$$\text{HHI}_{jt} := \sum_{i=1}^{N_j} s_{ijt}^2, \quad (5)$$

where  $N_j$  is the number of firms in industry  $j$  and  $s_{ijt}$  is the market share of firm  $i$  in industry  $j$  in year  $t$ . The choice of the 3-digit SIC code is described as the best option for classifying industries for this type of research, as 4-digit SIC codes often split an industry unnecessarily and 2-digit SIC codes group industries that are not sufficiently related to adequately represent industry competition (Giroud & Mueller, 2010).

### 3.2.7 Control variables

While the extension of this paper is about industry competitiveness, Qiang et al. (2022) already controlled for industry growth (`ind_growth`) and industry dynamism (`ind_dynamism`). The rationale for using these controls is again based on the information processing perspective. Greater industry growth is expected to reduce the need for information processing because external threats are less of a problem. However, greater industry dynamism is expected to increase information processing demands because there is a greater need to acquire and process information about external circumstances. These control variables are constructed by running a regression for each unique 3-digit SIC code, regressing industry turnover on financial year. The coefficient on the dependent variable is divided by the mean of industry turnover and stored as `ind_growth` and the standard error of the regression is also divided by the mean of industry turnover and stored as `ind_dynamism` (Dess & Beard, 1984).

Based on Hillman and Dalziel (2003) certain ownership characteristics are included as control variables. The variables of institutional ownership (`insti_ownershipt`) and institutional blockholder ownership (`blockholdert`) are included as control variables due to the fact that institutional investors monitor more closely. The former is defined as the percentage of equity shares held by institutional investors, while the latter is defined as the percentage of outstanding equity shares owned by institutional investors who are also blockholders. In order to be classified as a blockholder, an individual or entity must possess a proportion of outstanding shares that exceeds 5% of all outstanding shares. In order to control for the board of directors' equity ownership, the percentage of equity ownership held by the board of directors (`board_equityt`) is employed.

In order to account for the formal board structure following turnover, various measures are employed in year  $t$ . First of all, changes in board job-related diversity (`chg_ceopowert`) and changes in CEO power relative to the board (`chg_boarddiversityt`) are incorporated. These change variables are incorporated to address concerns regarding multicollinearity. The change in board job-related diversity is determined by the difference between the job-related board diversity measure in year  $t-3$  and year  $t$ . Similarly, the change in CEO power relative to the board is calculated as the difference between the CEO power measure in year  $t-3$  and year  $t$ .

Moreover, board size (`boardsize`) and board tenure (`boardtenure`) are incorporated for each year. Qiang et al. (2022) deemed it unnecessary to introduce a separate control for board

independence since this aspect is already captured in the measurement of CEO power relative to the board.

Lastly, the amount of slack (slack) which a company has - defined as current assets divided by current liabilities - and firm size (size) - defined as the natural logarithm of sales - are controlled for (Shen & Cannella, 2002). Similar to Qiang et al. (2022), the unadjusted ROA in year  $t$  (roa) is also controlled for the avoid potential "regression to the mean".

### 3.3 Summary statistics

In Table 3.1 the summary statistics and correlations between the variables are displayed. The measure for boardturnover shows an average value of 40.9%, with a relatively large standard deviation. Meaning that turnover differs substantially between firms, which is consistent with Qiang et al. (2022), who find a mean of 53% for boardturnover. Most of the summary statistics show similar results to Qiang et al. (2022), but some variables show notable differences. First of all, ind\_dynamism is a tenfold smaller in this study, but the standard deviation shows the same proportional difference. Moreover, the median-adjusted roa (roa) is positive compared to the slightly negative mean in the sample of Qiang et al. (2022). This difference could be explained by the addition of the economically positive years 2016-2020 in the sample of this paper. Another difference in the sample can be found in the ownership data. Whereas insti\_owner and blockholder are very similar to Qiang et al. (2022) when missing values are set to zero, they are now both notably larger in the sample of this paper. The board\_equity variable, on the other hand, is much smaller in this paper's sample. Another board characteristic that differs markedly is pt\_ceopower, which is almost ten times larger, but the ratio to the standard deviation is in line with the sample of Qiang et al. (2022). The Herfindahl-Hirschman index has a mean of 0.186 with a high standard deviation, which seems to be in line with the sample of Giroud and Mueller (2010), which reports a mean of 0.225. Regarding Table 3.1, the main takeaways about the sample are that firms with a higher magnitude of board turnover are associated with lower firm performance, less slack, lower industry competitiveness and a higher board size and lower board tenure. More surprisingly, size is not significantly correlated with boardturnover in the sample.

Figure 1 shows a time-series plot of the averages of the two main variables of interest: board turnover and subsequent median-adjusted ROA.

Table 3.1: Summary statistics and correlations

	VARIABLES	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11
1	boardturnover	0.409	0.345	0.000	4.000	1.0000										
2	ind_growth	0.039	0.029	-0.167	0.189	0.0337	1.0000									
3	ind_dynamism	0.002	0.002	0.000	0.035	-0.0264	-0.1601	1.0000								
4	roa	0.013	0.168	-1.259	0.664	-0.0693	-0.0246	0.0267	1.0000							
5	size	6.643	2.133	-6.215	11.457	0.0091	-0.0692	0.1043	0.4455	1.0000						
6	slack	2.820	2.457	0.318	20.470	-0.0289	0.0587	-0.0848	-0.0498	-0.4182	1.0000					
7	boardsize	8.540	2.254	1.000	20.000	0.0266	-0.1029	0.0479	0.1952	0.6165	-0.2441	1.0000				
8	boardtenure	9.503	4.533	0.125	35.650	-0.4520	-0.0833	0.0714	0.0856	-0.0150	0.0632	-0.0764	1.0000			
9	chg_boarddiversity	0.029	1.150	-8.006	7.551	-0.0238	-0.0111	-0.0022	0.0122	0.0321	0.0070	0.0550	0.0436	1.0000		
10	chg_ceopower	-0.157	1.938	-13.038	13.448	0.0236	-0.0129	-0.0013	0.0059	0.0074	-0.0066	0.0106	-0.0065	-0.1185	1.0000	
11	dummy_ceoturnover	0.146	0.353	0.000	1.000	0.1109	-0.0020	-0.0123	-0.0210	0.0490	-0.0249	0.0676	-0.0808	0.0377	-0.2022	1.0000
12	board_equity	0.004	0.026	0.000	0.915	-0.0018	0.0565	0.0200	0.0353	0.1087	-0.0321	0.1031	0.0445	-0.0025	0.0449	-0.0039
13	insti_ownership	0.673	0.273	0.000	1.000	-0.0242	0.0173	-0.0177	0.3049	0.4945	-0.0907	0.3077	-0.0473	0.0184	-0.0053	0.0106
14	blockholder	0.222	0.134	0.000	0.820	-0.0276	-0.0046	-0.0044	0.0743	0.0571	0.0412	0.0028	-0.0096	-0.0055	-0.0090	-0.0178
15	pt_boardtenure	8.903	4.929	0.080	39.900	-0.1281	-0.0885	0.0631	0.1001	0.0278	0.0590	-0.0095	0.8422	0.0608	0.0069	-0.0242
16	pt_boarddiversity	-0.056	1.716	-6.965	5.085	0.1134	-0.0137	-0.0005	0.0480	0.2695	-0.0772	0.2078	-0.1313	-0.3255	0.0385	0.0606
17	pt_ceopower	1.539	2.241	-1.930	19.760	-0.0080	-0.0297	0.0385	0.0662	0.1809	-0.1002	0.1330	0.0112	0.0417	-0.3866	0.0031
18	ROA_M1_3	0.017	0.161	-1.214	0.662	-0.0702	-0.0279	0.0096	0.8144	0.4235	-0.0785	0.2115	0.0720	0.0116	0.0001	-0.0168
19	ROA_1_3	0.094	0.163	-1.126	0.388	-0.0983	-0.0375	0.0979	0.7038	0.5439	-0.2010	0.2254	0.1358	0.0137	-0.0027	-0.0086
20	HHI	0.186	0.175	0.032	1.000	-0.0551	-0.0575	0.5801	0.0291	0.1728	-0.1143	0.0962	0.0955	-0.0062	-0.0036	-0.0060

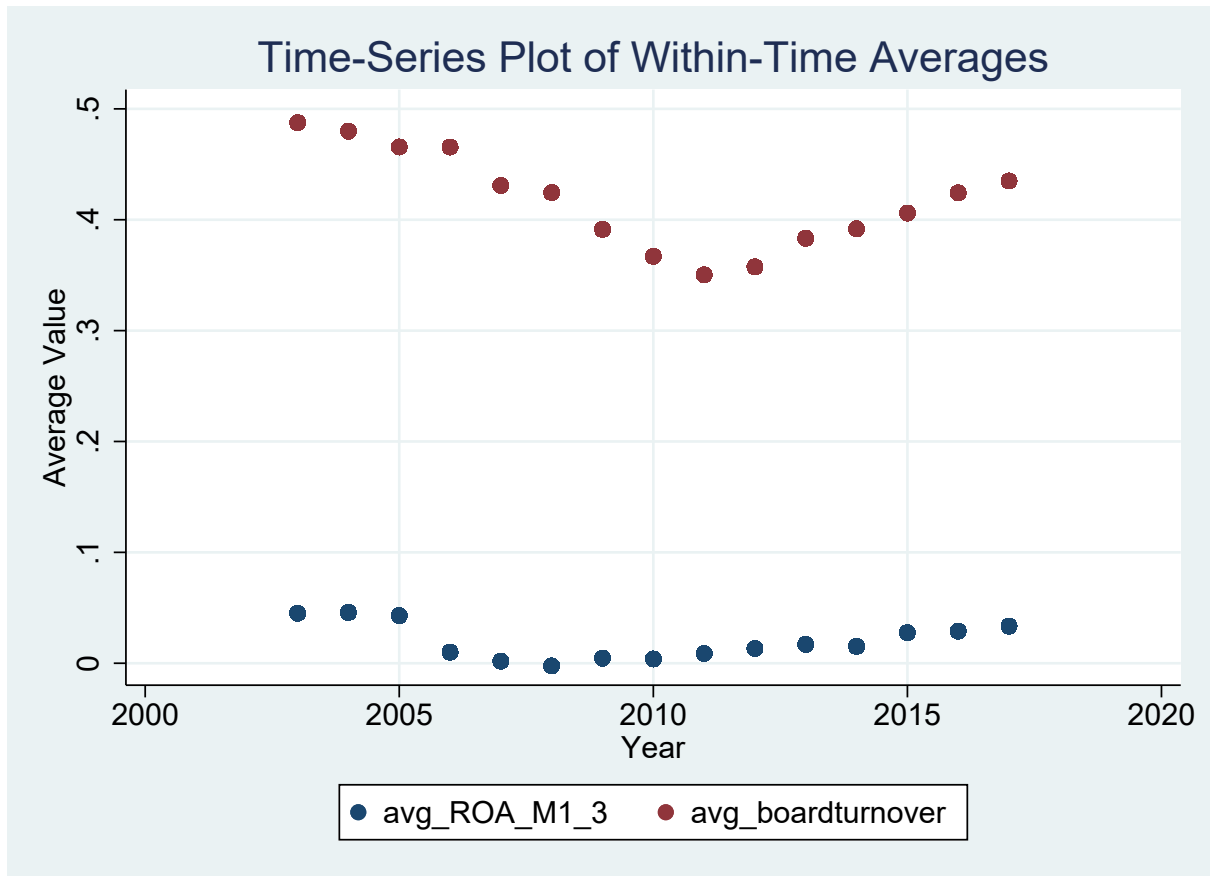
This table presents the sample descriptive statistics and Pearson's correlation between variables. The full sample includes 15,406 firm-year observations from 2003 to 2020. The correlation coefficients with absolute values greater than 0.0158 are statistically significant at a level of  $p < 0.05$

Continuation of Table 3.1

VARIABLES	12	13	14	15	16	17	18	19	20
12 board_equity	1.0000								
13 insti_ownership	0.0377	1.0000							
14 blockholder	-0.0186	0.6207	1.0000						
15 pt_boardtenure	0.0398	-0.0272	-0.0098	1.0000					
16 pt_boarddiversity	0.0436	0.1398	-0.0156	-0.0901	1.0000				
17 pt_ceopower	0.0892	0.0394	-0.0514	-0.0209	0.0222	1.0000			
18 ROA_M1_3	0.0320	0.3142	0.0958	0.0880	0.0526	0.0603	1.0000		
19 ROA_1_3	0.0555	0.3456	0.0930	0.1473	0.0583	0.0795	0.8277	1.0000	
20 HHI	0.0277	0.0604	0.0259	0.0870	0.0256	0.0363	0.0130	0.1303	1.0000

This table presents the sample descriptive statistics and Pearson's correlation between variables. The full sample includes 15,406 firm-year observations from 2003 to 2020. The correlation coefficients with absolute values greater than 0.0158 are statistically significant at a level of  $p < 0.05$

Figure 1: Time-Series Plot of Within-Time Averages



## 4 Methodology

OLS regressions are used to analyse the available data. Following Qiang et al. (2022), all continuous variables are winsorised at 1% and 99% to exclude potential outliers in the data set. This winsorizing improves the stability of the estimates, and ensures that the results are not wrongly affected by extreme data points. In addition, firm-clustered robust standard errors are used in all regressions to improve the accuracy of the regression results by adjusting for potential within-firm correlations over time. Furthermore, it is assumed that autocorrelation is present since the data sample is panel data. Additionally, heteroscedasticity is assumed. Because of this firm-clustered robust standard errors are applied. Firm-clustered robust standard errors account for time-series correlation within each firm. Moreover, they mitigate heteroskedasticity by adjusting the standard errors to be robust against violations of the homoskedasticity assumption. For that reason, firm-clustered robust standard errors are applied in all regressions. The main effect is tested by estimating the following regression:

$$y_{it} = \beta_0 + \beta_1 \text{boardturnover}_{it} + \sum_j \gamma_j X_j + \epsilon_{it} \quad (6)$$

where  $y_{it}$  is the dependent variable is the subsequent firm performance for firm  $i$  at time  $t$ ,  $\beta_0$  is the constant term and  $\text{boardturnover}_{it}$  is the independent variable of interest. Each unit increase of board turnover results in a change of subsequent firm performance by  $\beta_1$ .  $\gamma_j$  is the coefficient for each individual control variable  $X_j$ , the summation  $\sum_j$  represents all control variables included in the model and  $\epsilon_{it}$  is the error term.

The moderating role of industry competition is tested using an interaction term, as are board tenure, board diversity and CEO power.

The estimation is:

$$y_{it} = \beta_0 + \beta_1 \text{boardturnover}_{it} + \beta_2 \text{moderator}_{it} + \beta_3 (\text{boardturnover}_{it} \times \text{moderator}_{it}) + \sum_j \gamma_j X_j + \epsilon_{it} \quad (7)$$

where  $\text{moderator}_{it}$  is the moderator applied in the specific regression (HHI, board tenure, board diversity or CEO power),  $\beta_3$  is the coefficient for the interaction term between board turnover and the moderator.

The coefficient  $\beta_1$  measures the (limit) effect as the moderator goes to zero. So, when HHI is used as the moderator it will estimate the effect of board turnover on firm performance in highly competitive industries. The coefficient  $\beta_3$  measures how the effect varies with the magnitude of the moderator and the coefficient  $\beta_2$  measures the direct effect of the moderator.

To test Hypothesis 2, the variable boardturnover is categorized into quartiles, resulting in the following estimation:

$$y_{it} = \beta_0 + \beta_1 \text{Q2\_boardturnover}_{it} + \beta_2 \text{Q3\_boardturnover}_{it} + \beta_3 \text{Q4\_boardturnover}_{it} + \sum_j \gamma_j X_j + \epsilon_{it} \quad (8)$$

where the coefficients  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  measure the effect of a firm experiencing a magnitude

of board turnover in the respective quartile compared to experiencing a magnitude of board turnover in the lowest quartile. If the effect of board turnover on subsequent firm performance is linear, then all coefficients will have the same sign and the coefficients will not get smaller with every next quartile.

## 5 Results

### 5.1 Main effects

Table 5.1 reports the main effects tested, which will primarily answer Hypothesis 1. In Model 1, all control variables are regressed on firm performance without the inclusion of boardturnover in order to test the assumptions made about these control variables. Industry dynamism, institutional ownership, board size and firm size influence firm performance just as, logically, ROA does.

Interestingly, industry dynamism has a significantly negative effect on firm performance whereas Qiang et al. (2022) found the opposite. This finding could have a link to the difference in size of the mean of `ind_dynamism` which is described in Section 3.3. In this regression model the greater industry dynamism is in which the firm operates, the lower the firm performs. Larger firms, firms with a larger board and firms who's stocks are owned more by institutions perform better.

The variables board size and institutional ownership also have reversed signs to Qiang et al. (2022), but are positive in the model of this paper. Slack is significant at a 10% significance level but with a reversed sign to Qiang et al. (2022). Pre-turnover board tenure is significant at 10% in all models and only slightly above the 5% level in Model 1-4. The variable is positive, meaning that a more tenured board pre-turnover results in higher firm performance post-turnover.

Three remarkably insignificant variables are industry growth, board equity and blockholder as they were significantly influential in the similar model of Qiang et al. (2022). Meaning that in this sample, it is not relevant for firm performance whether the firm operates in an industry which is experiencing growth. Also, it is irrelevant how much equity the board of directors owns and how many blockholders there are of the stock of the firm.

In Model 2, board turnover is added to the model resulting in a negative coefficient which is just insignificant at the 5% level in Model 2. The variable is negative and therefore is in line with Hypothesis 1, which states that there will be a negative relationship between the magnitude of board turnover and subsequent firm performance.

In Model 3, the extension of this paper, industry competitiveness, is added in the form of the HHI measure. HHI has a significant negative effect on firm performance, meaning that firms with a higher HHI (so operating in less competitive industries) have worse firm performance. In addition, in Model 3 industry dynamism becomes insignificant due to HHI being included, which points to multicollinearity between the two variables. Which is not unlogical, since both variables are based on industry sales. Moreover, board turnover does become significant at the 5% level in Model 3.

Model 4 in Table 5.1 excludes all (seemingly) insignificant control variables and only keeps

seven control variables. This exclusion does not reduce the R-squared of the regression and thus the estimation explains the variance just as well as the previous three Models. Moreover, in Model 4 the coefficient of board turnover becomes larger (in absolute terms) and more significant.

This combination of an increase in significance of boardturnover and the unchanged R-squared might mean that the original model included irrelevant or collinear controls. This gives substance to the argument that the first three models are actually overfitted.

Model 5 is a sensitivity test, where the dependent variable changes. The dependent variable is the unadjusted subsequent firm performance (ROA\_1.3) and instead industry fixed effects are applied to control for industry specific effects. The coefficient for size increases to almost four times as large as in Model 4 and also rises steeply in significance. The coefficient for slack becomes slightly larger as well and rises in significance. More interestingly, the coefficient for board size changes signs and has a significant negative effect on firm performance in this estimation. HHI becomes insignificant in this regression which is most likely due to multicollinearity with the industry measurement (3-digit sic code). The main variable of interest, board turnover, gains in significance and absolute size. Also, the R-squared has increased, meaning that the variance is better explained by this model.

Table 5.1 shows that Hypothesis 1, which stated that there would be a negative relationship between firm performance and board turnover, is accepted. Mainly on the basis of Model 4 and Model 5.

Table 5.1: Main effects of magnitude of board turnover on subsequent firm performance

VARIABLES	(1) ROA_M1_3	(2) ROA_M1_3	(3) ROA_M1_3	(4) ROA_M1_3	(5) ROA_1_3
ind_growth	-0.0331 (-1.031)	-0.0310 (-0.965)	-0.0251 (-0.796)		
ind_dynamism	-1.392*** (-2.811)	-1.410*** (-2.848)	-0.454 (-0.948)		
roa	0.746*** (38.12)	0.746*** (38.00)	0.744*** (37.88)	0.745*** (38.06)	0.649*** (27.85)
size	0.00277** (2.422)	0.00279** (2.429)	0.00299*** (2.603)	0.00260** (2.451)	0.00987*** (7.936)
slack	-0.00120* (-1.883)	-0.00121* (-1.904)	-0.00125** (-1.964)	-0.00129** (-2.024)	-0.00206** (-2.557)
boardsize	0.00151** (2.561)	0.00152** (2.575)	0.00152*** (2.583)	0.00145** (2.440)	-0.00165*** (-2.693)
pt_boardtenure	0.000390* (1.882)	0.000339* (1.659)	0.000378* (1.839)	0.000399* (1.955)	0.000900*** (4.097)
pt_boarddiversity	-0.000633 (-0.861)	-0.000494 (-0.673)	-0.000499 (-0.680)		
chg_boarddiversity	-0.000643 (-0.645)	-0.000607 (-0.609)	-0.000648 (-0.649)		
pt_ceopower	-0.000438 (-0.862)	-0.000431 (-0.848)	-0.000441 (-0.869)		
chg_ceopower	-0.000716 (-1.389)	-0.000660 (-1.296)	-0.000671 (-1.319)		
dummy_ceoturnover	-0.00258 (-1.044)	-0.00187 (-0.773)	-0.00189 (-0.780)		
board_equity	-0.0154 (-0.859)	-0.0158 (-0.887)	-0.0159 (-0.874)		
insti_ownership	0.0287*** (4.323)	0.0284*** (4.290)	0.0286*** (4.316)	0.0318*** (5.700)	0.0323*** (5.471)
blockholder	0.00680 (0.732)	0.00688 (0.740)	0.00735 (0.790)		
boardturnover		-0.00668* (-1.876)	-0.00708** (-1.986)	-0.00761** (-2.121)	-0.0105*** (-2.767)
HHI			-0.0202*** (-3.819)	-0.0229*** (-5.012)	-0.00602 (-0.378)
Constant	-0.0410*** (-4.263)	-0.0379*** (-4.064)	-0.0375*** (-4.026)	-0.0368*** (-4.287)	-0.0388*** (-4.175)
Observations	15,406	15,406	15,406	15,406	15,406
R-squared	0.671	0.671	0.671	0.671	0.710
Industry FE	No	No	No	No	Yes

This Table presents the main effects of magnitude of board turnover on subsequent firm performance. The dependent variable ROA\_M1-3 is the average of industry median-adjusted ROA over 3 years, that is,  $t + 1$ ,  $t + 2$ , and  $t + 3$ . The  $t$  statistics (as shown in parentheses) are based on robust standard errors clustered at firm level. Model 1 tests the control variables by excluding the main variable of interest, Model 2 adds the main variable of interest, Model 3 also adds the extra measure of competition (HHI) and Model 4 excludes all insignificant controls. Model 5 uses industry fixed effects. \* $p < 0.10$ , \*\*  $p < 0.05$ ,

## 5.2 Categorical approach to board turnover

Table 5.2: Effects of categorized quartiles of board turnover on subsequent firm performance

VARIABLES	(1) ROA_M1_3
roa	0.747*** (38.26)
size	0.00264** (2.498)
slack	-0.00121* (-1.897)
boardsize	0.00148** (2.475)
insti_ownership	0.0316*** (5.675)
HHI	-0.0215*** (-4.677)
2.boardturnover_quartile	-0.00269 (-1.223)
3.boardturnover_quartile	-0.00399* (-1.842)
4.boardturnover_quartile	-0.00516* (-1.857)
Constant	-0.0343*** (-4.147)
Observations	15,406
R-squared	0.671

This Table presents the effect of board turnover, categorized into quartiles, on subsequent firm performance. The dependent variable ROA\_M1-3 is the average of industry median-adjusted ROA over 3 years, that is,  $t + 1$ ,  $t + 2$ , and  $t + 3$ . The  $t$  statistics (as shown in parentheses) are based on robust standard errors clustered at firm level. \* $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\* $p < 0.01$

Answering to Hypothesis 2, a regression is performed where the variable boardturnover is categorized into quartiles, the results are shown in Table 5.2. The first quartile, with the lowest board turnover, is omitted from the regression to serve as the reference group. The regression model contains all significant control variables from Model 4 in Table 5.1. The control variables do not differ unexpectedly from Table 5.1 but pre-turnover boardtenure does become significant at 5%. The coefficients of the categorized board turnover variables should be interpreted as the difference in effect between the reference group (first quartile) and the relevant quartile. Table 5.2 shows that each next quartile has a higher coefficient, where all coefficients are negative and the upper two quartiles are just statistically insignificant at 5%.

In answering Hypothesis 2, the sign, magnitude and significance of the coefficients must be taken into account. Since all signs are negative and the magnitude and significance of the coefficients increase with each quartile, Hypothesis 2 is rejected. This means that there is no evidence that categorising board turnover into quartiles shows a non-linear relationship between board turnover and firm performance.

### 5.3 Interaction effects

In Table 5.3, the effect of moderators are tested. All control variables behave accordingly and are similar to their signs and magnitudes in Table 5.1 & 5.2. Interestingly, none of the interaction effects are significant. Meaning that the measures for pre-turnover board diversity, pre-turnover ceo power, pre-turnover board tenure and industry competitiveness do not significantly moderate the negative relationship between board turnover and firm performance.

Model 1 shows that pre-turnover board diversity is not a significant control variable in itself, meaning that the diversity of the board, measured before the board turnover, does not influence firm performance. Moreover, the interaction term not being significant means that the effect of board turnover on firm performance does not vary with the level of pre-turnover board diversity. This means that Hypothesis 4, which stated that there would be a significant moderating effect, is rejected.

Similarly, Model 2 shows that pre-turnover CEO power has an insignificant main effect and an insignificant interaction effect with board turnover. Meaning that the effect of board turnover on firm performance does not vary with the pre-turnover magnitude of power of the CEO. This means that Hypothesis 5, which stated that there would be a significant moderating effect, is rejected

In Model 3, the interaction effect of board turnover with pre-turnover board tenure is tested. The effect is insignificant which entails that pre-turnover board tenure does not moderate the relationship between board turnover and firm performance. The main effect of `pt.boardtenure` is significant at 5% in all five models, similarly to the models in Table 5.1 & 5.2. However, Hypothesis 6, which stated that there would be a significant moderating effect, is rejected.

In Model 4, HHI shows a positive interaction term with `boardturnover` but the effect is not significant. Therefore, Hypothesis 3 is rejected. Whereas HHI does have a significant negative main effect in all regression models in Table 5.3. Unsurprisingly, Model 5 does not return any significant interaction effects either.

As a sensitivity analysis, these results are also estimated with unadjusted subsequent firm performance (`ROA_1_3`) but with the inclusion of industry fixed effects. The results of this sensitivity analysis do not show any changes in significance of the moderators. The most notable difference is that `pt.boarddiversity` becomes significant at 5% in the sensitivity analysis. The results are shown in Appendix A

Table 5.3: Interaction effects of magnitude of board turnover on subsequent firm performance

VARIABLES	(1) ROA_M1_3	(2) ROA_M1_3	(3) ROA_M1_3	(4) ROA_M1_3	(5) ROA_M1_3
ind_growth	-0.0258 (-0.818)	-0.0252 (-0.801)	-0.0249 (-0.792)	-0.0264 (-0.836)	-0.0249 (-0.789)
ind_dynamism	-0.435 (-0.897)	-0.440 (-0.900)	-0.454 (-0.935)	-0.461 (-0.933)	-0.472 (-0.948)
roa	0.744*** (37.86)	0.744*** (37.86)	0.744*** (37.84)	0.744*** (37.86)	0.744*** (37.85)
size	0.00300*** (2.614)	0.00299*** (2.604)	0.00305*** (2.656)	0.00299*** (2.606)	0.00300*** (2.614)
slack	-0.00126** (-1.985)	-0.00125** (-1.969)	-0.00124** (-1.965)	-0.00126** (-1.980)	-0.00126** (-1.989)
boardsize	0.00142** (2.388)	0.00142** (2.391)	0.00138** (2.324)	0.00143** (2.413)	0.00139** (2.342)
boardtenure	-0.000819 (-1.413)	-0.000839 (-1.445)	-0.00116* (-1.733)	-0.000795 (-1.379)	-0.00119* (-1.807)
pt_boarddiversity	-0.000910 (-0.850)	-0.000529 (-0.722)	-0.000532 (-0.730)	-0.000547 (-0.747)	-0.000897 (-0.840)
chg_boarddiversity	-0.000591 (-0.572)	-0.000691 (-0.694)	-0.000688 (-0.691)	-0.000718 (-0.721)	-0.000627 (-0.607)
pt_ceopower	-0.000388 (-0.765)	-0.000778 (-1.043)	-0.000364 (-0.716)	-0.000389 (-0.766)	-0.000807 (-1.084)
chg_ceopower	-0.000663 (-1.302)	-0.000609 (-1.170)	-0.000666 (-1.307)	-0.000680 (-1.330)	-0.000622 (-1.192)
pt_boardtenure	0.000976** (2.133)	0.000990** (2.160)	0.00153** (2.200)	0.000963*** (2.114)	0.00159** (2.314)
dummy_ceoturnover	-0.00206 (-0.854)	-0.00196 (-0.823)	-0.00209 (-0.867)	-0.00210 (-0.870)	-0.00200 (-0.837)
board_equity	-0.0136 (-0.740)	-0.0141 (-0.761)	-0.0131 (-0.713)	-0.0134 (-0.727)	-0.0132 (-0.716)
insti_ownership	0.0284*** (4.291)	0.0284*** (4.298)	0.0284*** (4.305)	0.0284*** (4.292)	0.0287*** (4.351)
blockholder	0.00733 (0.791)	0.00747 (0.804)	0.00717 (0.773)	0.00737 (0.794)	0.00710 (0.767)
boardturnover	-0.0108** (-2.242)	-0.0125** (-2.233)	-0.00592 (-0.799)	-0.0136** (-2.151)	-0.0104 (-1.172)
HHI	-0.0201*** (-3.785)	-0.0200*** (-3.751)	-0.0200*** (-3.765)	-0.0267*** (-3.228)	-0.0273*** (-3.308)
boardturnover * pt_boarddiversity	0.000982 (0.452)				0.000872 (0.405)
boardturnover * pt_ceopower		0.00101 (0.603)			0.00113 (0.683)
boardturnover * pt_boardtenure			-0.000792 (-1.001)		-0.000862 (-1.109)
boardturnover * HHI				0.0173 (1.064)	0.0190 (1.176)
Constant	-0.0326*** (-3.222)	-0.0319*** (-3.127)	-0.0337*** (-3.312)	-0.0316*** (-3.124)	-0.0317*** (-3.088)
Observations	15,406	15,406	15,406	15,406	15,406
R-squared	0.672	0.672	0.672	0.672	0.672

This Table presents the interaction effects of board turnover on subsequent firm performance. The dependent variable ROA\_M1-3 is the average of industry median-adjusted ROA over 3 years, that is,  $t + 1$ ,  $t + 2$ , and  $t + 3$ . Model 1 - 4 all include one of the different interaction terms and Model 5 includes all interaction terms. The  $t$  statistics (as shown in parentheses) are based on robust standard errors clustered at firm level. \* $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\* $p < 0.01$

## 6 Discussion

### 6.1 Main effect

The first objective of this paper was to test whether the findings of Qiang et al. (2022) could be replicated. Specifically, this study investigated the main effect of board turnover on firm performance. The results indicate that the main effect of board turnover on firm performance identified by Qiang et al. (2022) is similarly found in this paper. Both are negative effects which mean that magnitude of board turnover negatively effects subsequent firm performance. The coefficient is about two times as large for Qiang et al. (2022) however, as they report a coefficient of -0.017 and this paper finds a coefficient of -0.008 in Model 4 of Table 5.1. The theoretical approach using the information processing perspective demonstrated by Qiang et al. (2022) also finds some fertile ground in the sample of this paper.

This result shows that there is still much to learn about the effect which boards of directors have on firm performance and fuels the discussion for what role board diversity and board renewal should play.

### 6.2 Effect of using factor variables

Based on Anderson and Chun (2014) it was expected that a 'sweet spot' for board turnover was to be found in the relationship between board turnover and firm performance. However, the categorization of board turnover into quartiles did not result in any findings to support this hypothesis. The quartiles predicted worse firm performance the higher the quartile was. Therefore, Hypothesis 2 was rejected. Given the findings of Qiang et al. (2022) and the descriptive and brief nature of Anderson and Chun (2014) this rejection is maybe not surprising. No other published scientific paper has yet proven that there is a 'sweet spot' in board turnover with regards to firm performance, despite the intuitive attractiveness of the argument.

Therefore, as this paper is not able to nuance the main findings of Qiang et al. (2022) and given the confirmation of their results with regards to Hypothesis 1, the negative relationship deserves more academic attention.

### 6.3 Moderators

The main objective of this paper was to research whether the findings of Giroud and Mueller (2010) could help understand the effect which board turnover has on firm performance. If the conclusion of their paper is justified, it should have broad scale implications, which could reach the board room. Hypothesis 3 stated that given that corporate governance matters less in competitive industries, industry competitiveness should moderate the influence which board turnover has on firm performance. The hypothesis was rejected on the basis of the results in Table 5.3, which showed that the interaction term between board turnover and industry competitiveness was insignificant.

If corporate governance is indeed less important in competitive industries, then this finding shows that one cannot find this distinction when looking at the relationship between board turnover and firm performance. It might also be the case that the importance of corporate

governance is not necessarily reliant on industry competitiveness but on other industry characteristics which Giroud and Mueller (2010) captured in their competition measure but this paper did not capture.

Moreover, Hypotheses 4-6 are all rejected due to the interaction effects being insignificant. This is in contrast to the findings of Qiang et al. (2022), who found all variables to significantly moderate the relationship between board turnover and firm performance. This contrast is remarkable and raises the question of generalisability of their findings. The implication of the finding is that next to the negative main effect, no evidence is found for the information processing perspective on board turnover.

#### **6.4 Sensitivity analyses**

The sensitivity analyses performed in this paper showed interesting differences but did not show a change in the main effect or the moderating effects. However, the results were clear in illustrating that different methodological approaches can result in different results in this empirical setting. Whereas using industry fixed effects showed some more promising effects, it was not adequate for researching the effect of industry competitiveness due to multicollinearity.

#### **6.5 Influence of industry competitiveness on firm performance**

The moderating role of industry competitiveness is incorporated in Hypothesis 3. However, the influence of industry competitiveness on firm performance was, deliberately, not taken into account for this hypothesis. This paper found a significant negative effect of HHI on firm performance, meaning that firms operating in a more competitive industry experience higher firm performance.

The influence of industry competition on firm performance is an interesting and much researched relationship. For example, Brown and Earle (2000) researched Russian firms in a quasi-experimental setting in the period after the fall of the Soviet Union to see how this large jump in industry competitiveness impacted firm performance. The authors found that the increase in competition increased firm performance (total factor productivity). Similarly, Januszewski et al. (2002) find evidence from Germany that productivity grows when competition increases. In an important literature review, Holmes and Schmitz (2010) conclude that studies generally find that increases in competition lead to significant productivity gains. Moreover, Nickell (1996) finds that competition as measured by more competitors or lower profit margins, is associated with significantly higher rates of total factor productivity growth. Nickell (1996) also argues that reverse causality might be a problem for this relationship, where a higher productivity will drive up the market share of a company, resulting in less competition. Given that this paper finds the opposite relationship, this might mean that the actual relationship is even higher.

However, Giroud and Mueller (2010) find that HHI has a significant positive impact on ROA. Meaning that firms with a higher index (lower competition) have a higher return on their assets. They state that their finding follows the conventional thought that competition reduces profits. The measure for firm performance, ROA, can be viewed as a measure which represents

a mixture of profitability and efficiency, however. The assumption that firms in less competitive industries make higher profits does not necessary entail that ROA is higher for these firms.

A potential explanation for the difference in findings between Giroud and Mueller (2010) and this paper can be found in the inclusion of the slack variable in this paper. This variable is assumed to be higher for firms in less competitive industries.

Although this paper did not aim to research the direct relationship of industry competitiveness on firm performance, the negative effect is an interesting find. Which could have practical implications for investors.

## 7 Conclusion

In this paper, I have looked at the relationship between board turnover and firm performance and the potentially moderating role of industry competitiveness. Previous research has shown a negative relationship between board turnover and firm performance which was theoretically grounded in the information processing perspective (Qiang et al., 2022). However, the mechanisms behind the influence of board turnover on firm performance remained unclear. The role of industry competitiveness on corporate governance has been much researched, but has never been extended to test its relationship with board turnover. Therefore, the question which was studied in this paper was: 'How does board turnover affect firm performance, and does the impact differ between competitive and non-competitive industries?'

To answer this question, a dataset with 15,406 firm-year observations for 2,456 North American firms was analysed, which contained data about firm performance and board characteristics. The data originates from BoardEx, Compustat and Thomson Reuters. The moderating role was tested by use of a Herfindahl-Hirschman index, which was utilised as an interaction term in one of multiple OLS regressions which were estimated to analyse the data at hand. The results of these estimations showed a significant negative relationship between board turnover and firm performance. Meaning that a higher level of board turnover resulted in subsequent lower firm performance. This negative relationship was also confirmed in a regression which categorized board turnover into quartiles. Moreover, the moderating role of industry competitiveness was found to be insignificant, as were all other tested potential moderators.

This paper therefore concludes that firms who have experienced higher board turnover subsequently perform worse than firms who experienced lower board turnover. Moreover, industry competitiveness which was suggested to reduce the importance of corporate governance in previous literature, is not found to reduce the importance of board turnover. Next to the main effect, no evidence is found for the information processing perspective of board turnover. Additionally, this paper found that industry competitiveness is associated with higher firm performance.

Combined with previous research, this paper confirms that firms should be cautious with board replacements. Concerns of entrenched or captured boards might not be effectively addressed when board members are substituted.

## 8 Limitations

This paper largely replicates the data and methodology of Qiang et al. (2022). Their clear description of the data collection has helped to recreate almost all variables seamlessly. However, due to data unavailability and time constraints, some variables have been left out. First of all, the meeting frequency of the boards has not been taken into account for this paper. Meeting frequency is an important indicator of the information processing ability of the board and therefore a potentially important moderator. Meeting frequency data cannot be found in common data sources and can only be retrieved by hand or machine learning models (Adams et al., 2021).

Another control variable of Qiang et al. (2022) which is not taken into account is the diversification of the business, which ought to influence firm performance. The significance of these variables was varying in their research.

Regarding the moderators used in this paper, there are also some limitations compared to Qiang et al. (2022). For board diversity, 3 out of 4 indicators are used to compute the measure. The measure for functional expertise could not be computed due to data unavailability which might be an explanation for the insignificance of the variable.

The measure of industry competitiveness, HHI, is an imperfect measure. The measure does not regard geographical obstacles for example, which can lead to wrongly identified competitiveness.

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## Appendix A Sensitivity analysis of interaction effects

Table A.1: Interaction effects of magnitude of board turnover on subsequent firm performance

VARIABLES	(1)	(2)	(3)	(4)	(5)
	ROA_1_3	ROA_1_3	ROA_1_3	ROA_1_3	ROA_1_3
roa	0.621*** (27.35)	0.620*** (27.33)	0.621*** (27.34)	0.621*** (27.34)	0.620*** (27.34)
size	0.0119*** (8.582)	0.0119*** (8.566)	0.0119*** (8.586)	0.0119*** (8.568)	0.0119*** (8.573)
slack	-0.00188** (-2.248)	-0.00187** (-2.239)	-0.00187** (-2.236)	-0.00188** (-2.246)	-0.00188** (-2.258)
boardsize	-0.00205*** (-3.167)	-0.00205*** (-3.167)	-0.00207*** (-3.198)	-0.00203*** (-3.144)	-0.00207*** (-3.203)
boardtenure	-0.000656 (-1.043)	-0.000686 (-1.086)	-0.000804 (-1.122)	-0.000633 (-1.013)	-0.000860 (-1.209)
pt_boarddiversity	-0.00244** (-2.161)	-0.00208*** (-2.634)	-0.00209*** (-2.645)	-0.00210*** (-2.665)	-0.00244** (-2.154)
chg_boarddiversity	-0.00103 (-0.976)	-0.00112 (-1.090)	-0.00113 (-1.093)	-0.00116 (-1.121)	-0.00107 (-1.012)
pt_ceopower	6.20e-05 (0.109)	-0.000463 (-0.567)	7.16e-05 (0.125)	6.27e-05 (0.110)	-0.000478 (-0.587)
chg_ceopower	-0.000345 (-0.646)	-0.000276 (-0.505)	-0.000348 (-0.650)	-0.000366 (-0.681)	-0.000288 (-0.527)
pt_boardtenure	0.00149*** (2.992)	0.00151*** (3.018)	0.00174** (2.336)	0.00147*** (2.972)	0.00180** (2.459)
dummy_ceoturnover	-0.00176 (-0.717)	-0.00163 (-0.670)	-0.00178 (-0.724)	-0.00179 (-0.728)	-0.00165 (-0.677)
board_equity	0.00538 (0.237)	0.00478 (0.210)	0.00581 (0.256)	0.00600 (0.264)	0.00579 (0.254)
insti_ownership	0.0342*** (4.813)	0.0342*** (4.818)	0.0342*** (4.827)	0.0342*** (4.816)	0.0345*** (4.866)
blockholder	-0.00942 (-0.909)	-0.00930 (-0.897)	-0.00952 (-0.919)	-0.00951 (-0.918)	-0.00962 (-0.929)
boardturnover	-0.0152*** (-2.810)	-0.0175*** (-2.770)	-0.0131 (-1.557)	-0.0186** (-2.570)	-0.0184* (-1.802)
HHI	0.0186 (1.056)	0.0194 (1.106)	0.0187 (1.062)	0.0105 (0.559)	0.0110 (0.582)
c.boardturnover#c.pt_boarddiversity	0.000911 (0.421)				0.000842 (0.391)
c.boardturnover#c.pt_ceopower		0.00135 (0.752)			0.00142 (0.803)
c.boardturnover#c.pt_boardtenure			-0.000349 (-0.404)		-0.000436 (-0.514)
c.boardturnover#c.HHI				0.0214 (1.139)	0.0222 (1.198)
Constant	0.00400 (0.369)	0.00490 (0.451)	0.00352 (0.323)	0.00526 (0.486)	0.00580 (0.530)
Observations	15,406	15,406	15,406	15,406	15,406
R-squared	0.691	0.691	0.691	0.691	0.691