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The American University in Cairo  
School of Business

## **Board Monitoring and Firm Performance: Evidence from the UK**

A Thesis Submitted to  
The Department of Management  
in partial fulfillment of the requirements for  
the degree of Master of Science in Finance  
by  
Asmaa Aly Hanafy  
Under the supervision of Dr. Nermeen Shehata

December 2019

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## **Abstract**

There are several research papers regarding the relationship between corporate governance and firm performance. One of the aspects of corporate governance is the board of directors. Board monitoring is a critical aspect which can be measured by number of board meetings and number of board committees. There are several studies on board diversity and composition of board of directors and firm performance, while there are few research studies on the number of board committees and board meetings and their relationship with the firm performance. Accordingly, this thesis focuses on the relationship between board monitoring measured by number of board meetings and number of board committees and firm performance in the UK. The sample is Financial Times and London Stock Exchange (FTSE) 150 which includes the largest 150 listed companies on London Stock Exchange. Firm performance is measured by an accounting measure which is return on assets (ROA) and a market performance measure which is Tobin's Q. The results of this study show that there is no significant relationship between number of board meetings and firm performance. However, there is a significant negative relationship between number of board committees and firm performance.

Keywords: board committees, board meetings, corporate governance, firm performance, FTSE150, UK.

## **1.Introduction**

Corporate governance is an essential component that controls companies' operations. It sets specific guidelines for management to make sure that stakeholders' rights are maintained. There are several definitions of corporate governance. One of these definitions stated by Zingales (1998: 4) is that corporate governance means the "allocation of ownership, capital structure, managerial incentive schemes, takeovers, board of directors, pressure from institutional investors, product market competition, labour market competition, organizational structure, etc., can all be thought of as institutions that affect the process through which quasi-rents are distributed". Shleifer and Vishny (1997: 4) stated that corporate governance is "the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment". Srivastava, Das and Pattanayak (2018: 2) defined corporate governance as "a set of predefined rules which guide the actions of managers resulting in the best interest of investors". This thesis focuses on the definition illustrated by Srivastava, Das and Pattanayak (2018) since it is the most relevant one to this study.

The theory which is pertinent to this thesis is the agency theory. Bendickson, Muldoon, Liguori and Davis (2016) argued that agency theory is applied to various disciplines. Agency theory deals with the relationship between principal and agent. The principal has certain goals to be achieved and the agent has responsibilities that should be performed. If the actions of the agent are not aligned with the interests of the principals, this will lead to conflict of interest between them. According to the agency theory, the agents are the management of the company while the principals are the shareholders of the company. The goal of the shareholders is to maximize their wealth to increase firm performance. The agents work on behalf of the firm which has the money of the shareholders. Sometimes, there is conflict of interest that occurs between the shareholders and management of the company. Accordingly, governance is needed to resolve this agency problem. The board of directors is one of the solutions for this issue as they oversee the actions of the management to help them work in the best interest of the shareholders.

According to the Organisation for Economic Co-operation and Development (OECD), six principles of corporate governance are addressed. The first principle deals with the transparency and the fairness of the market. The second principle illustrates the rights of the shareholders and the fairness in their treatment. Stock markets, institutional investors and other intermediaries are the focus of the third principle. The

fourth principle interprets stakeholders' roles. The fifth principle is about transparency and disclosure, while the sixth principle is the roles and responsibilities of the board of directors (OECD Principles of Corporate Governance, 2015)

This thesis focuses on the last principle of corporate governance which is the roles and responsibilities of the board of directors and their relationship with firm performance. It examines the effect of board monitoring on the firm performance in UK. This thesis will contribute to the literature since there are few research studies about the number of board committees, which is one of the independent variables, and their effect on firm performance. This thesis is divided into five sections: introduction, the literature review, the research methodology, the results, and the conclusion.

## **2.Literature review**

### **2.1 Board functions and its effectiveness**

An essential aspect for board of directors is their effectiveness. Masli, Sherwood and Srivastava (2018) argue that certain aspects should be taken into consideration to ensure the effectiveness of the board. The first aspect deals with the independence of board members. They found that the higher the number of independent board members, the better the effectiveness of the board. That is due to their ability to strive for achieving the goal of the shareholders which is maximizing their wealth. There are also laws that enhance this independence aspect. For example, the Sarbanes Oxley act (SOX) in the section 301, requires that all members in audit committee should be independent. It was also required by New York Stock Exchange (NYSE) and National Association of Securities Dealers Automated Quotations (Nasdaq) (Masli, Sherwood and Srivastava, 2018). NYSE is a large stock exchange based in New York (NYSE, 2018). Nasdaq is also located in New York and is the largest electronic stock exchange in the world (The Nasdaq story, 2018). There should be more independent board members especially in the compensation and nomination committees. Nomination and compensation committees should have all their members independent. Accordingly, after the issuance of SOX, firms are more likely to have more independent members than before. They also prefer not to have the chief executive officer (CEO) and the chairman of the company to be the same person. The activity of board members is the second aspect which is measured by the frequency of board meetings and the attitude of the board members themselves such as how they prepare for the meetings, their attendance, participation and follow up. Regulators believe that the board effectiveness

increases as the board activity increases. The third characteristic is about the competence of the board members, it illustrates that as the competency of board members such as their expertise and their knowledge about the firm processes and its industry increase, their ability to monitor and guide the management will improve. The behavioral attributes of board members are the last feature, it deals with their capabilities to work as one team, reach effective solutions and encourage good relationships among the board members (Masli, Sherwood and Srivastava, 2018). This thesis focuses on the second aspect of board effectiveness which is the activity of the board members. It will be measured by number of board meetings and number of board committees.

## **2.2 Board of directors and firm performance**

Various aspects about board of directors were examined by previous research such as: board size, board composition and board monitoring. Bachiller, Giorgino and Paternostro (2014) argue that several studies illustrate the relationship between the structure of the board of directors and firm performance. These studies usually focus on two aspects which are the board size and the composition. Regarding the size, they concluded that board size and company performance are negatively correlated. This negative relationship is due to the concept of ‘free-riders’. Because of the increase in board size, not all members will participate in the decision-making process. Accordingly, some of them will take the role of free-riders and this will negatively impact firm performance. Other studies argue that there is no relationship between board size and firm performance (Beiner, Dorbetz, Schmid and Zimmermann, 2004), while some studies suggested that board size depends on the type of organization. These studies support that there is a positive relationship between the board size and firm performance (represented by Tobin’s Q) in complex entities. These entities are high debt and diversified entities (entities have various businesses or products that are not related). Diversified companies need higher level of board monitoring than other types of companies since they have different business segments that require diverse backgrounds. This can be achieved by having a large board size including several outsiders that have distinct backgrounds. On the other hand, since high debt firms need more advice to secure external resources such as debt, they also require a large board size (Coles, Daniel, Naveen, 2004).

Rashid, Dezoysa, Lodh and Rukin (2010) stated that composition deals with the presence of outside board members. They examined this relationship in Bangladesh using 274 observations. They concluded that there is no relationship between the board composition (represented in terms of the presence of independent outside directors) and firm performance. A negative relationship between board size and firm performance (measured by ROA) was also concluded. These results are due to “information asymmetries between outside independent and other directors. Therefore, it is supportive that outside independent directors of Bangladeshi firms are not able to ensure the checks and balances of accountability and management activities” (Rashid, Dezoysa, Lodh and Rukin, 2010: 89). This aspect is quite debatable because several studies argue that there is a strong relationship between board composition and the firm performance and others argue that there is no relationship at all. These variances may be due to external factors such as: corporate law, capital markets law, life cycle of the company or different strategies of the companies. However, results are not consistent, the firm performance might be affected indirectly by the board based on the quality of monitoring. (Dezoysa, Lodh and Rukin, 2010).

Ebenzer (2017), conducted a study using 137 companies in Nigeria and Ghana from 2008 to 2014, to check the relationship between board monitoring and firm performance. It was concluded that there is a positive relationship between the intensity of board monitoring and firm performance. “Intense monitoring enables directors to be informed and better understanding of important developments within the firm, and better position to timely take decisions to address emerging critical problems and improve performance” (Ebenzer, 2017: 36).

Brick and Chidambaran (2010) extended previous studies performed by Vafeas (1999) and Adams (2005) and conducted it on a larger sample covering the period from 1999 to 2005 on companies in the United States of America. They examined the relationship between board monitoring and firm performance by using the logarithm of board meetings and the logarithm of the product of annual board meetings and number of independent board members as the measure for board monitoring activity. They also added corporate events such as mergers and acquisitions in their study. Moreover, they took into consideration the independence of board members, duality of the CEO (when the chair and the CEO are the same), external factors that could pressure the firm to increase board monitoring activity. They concluded that board monitoring is positively



affecting the firm value (represented by Tobin's Q). Their study also concludes that board monitoring does not improve ROA, so the key role of the board is to improve the investment opportunities not the current performance of the firm. The positive results between board monitoring and Tobin's Q are because as the board monitoring intensity increases, the board will provide more vital advice which will consequently help the management of the firm to boost the firm's investment opportunities and finally increase the firm value. Their results also confirm that there is no relationship between firm performance and increasing independence of board members. The effects of the regulations for the board monitoring depend on the situation. If the board monitoring increased to comply with the rules only, in order not to get into trouble, this will negatively affect the performance of the firm because the management will concentrate on following the rules and will become unfocused on the main goal of the company which is maximizing the shareholders' wealth (Brick and Chidambaran, 2010).

The variables that are examined in this thesis as measures of board monitoring are: number of board meetings and number of board committees. On the other hand, number of independent board members and board size are among the control variables that are related to board monitoring. Literature review about these variables is discussed in the following sub-section of the thesis.

### **2.2.1 Number of board meetings and firm performance**

One of the variables that this thesis focuses on is the frequency of board meetings. This thesis aims to examine the relationship between number of board meetings and firm performance. According to a study that was conducted using data from Amman Stock exchange from 2009 to 2013, frequent board meetings lead to identifying more issues and collaborative engagement, producing good decisions and accordingly enhancing the performance of the firm (Al-Daoud, Saidin, Abidin, 2016). Another study was conducted to test the same variable for deposit money banks in Nigeria. The study uses Tobin's Q as the dependent variable representing firm performance and number of board meetings as the independent variable and they used two control variables: firm size and board size. They argue that there is a positive relationship between the number of board meetings and firm performance. The ability of board monitoring is getting better, when they meet more frequently and consequently

enhances the firm performance and maximizing shareholders' wealth (Eluyela, Akintimehin, Okere, Ozordi, Osuma, Ilogho and Oladipo, 2018).

Johl, Kaur and Cooper (2015), conducted a study on 700 listed Malaysian companies which includes financial and non-financial companies in 2009. It was concluded that there is a negative relationship between number of board meetings and firm performance (ROA). Frequent board meetings direct resources towards activities that are not fully productive.

Kaur and Vij (2017) studied the relationship between board characteristics and firm performance. They conducted this study using banks in India for the years between 2008 and 2014. They concluded that the number of board meetings, has a positive effect since the increase in the board meetings will enable the board members to exchange more ideas and the management will be more proactive and consequently decision making will be improved.

Another aspect related to board meetings is the attendance of the board of directors. The study concluded that if board of directors attend the meetings by themselves this affects the performance of the firm positively. On the other hand, if they authorize representatives to attend the meeting on their behalf, this would have an insignificant negative impact on the firm performance. The board members tend to attend the board meetings by themselves when they have higher qualifications which consequently affects firm performance positively (Chou, Chung and Yin, 2013).

Another study was conducted to measure the relationship between the number of board meetings and corporate value in South Africa on a sample of 169 listed companies covering the period from 2002 to 2007. It was concluded that high frequency of board meetings leads to high corporate performance. This happens because when the number of board meetings increases, board members can monitor and advise more effectively and consequently improve firm performance (Ntim and Osei, 2011).

Arora and Sharma (2016) studied the relationship between corporate governance and firm performance in India covering the period from 2001 to 2010. The study reveals that there is a positive relationship between the frequency of board meetings and firm performance. Monitoring will be better by meeting more frequently because board members will have more time to debate and discuss more issues.

### **2.2.2 Number of board committees and firm performance**

There is also a relationship between the board committees and firm performance. Most of the research focuses on the relationship between each committee and firm performance but there is little research about the relationship between the number of committees and firm performance. Lam and Lee (2012) conducted a study in Hong Kong for the period between 2001 to 2003 including 346 companies to check the relationship between board committees and firm performance. There is a positive relationship between nomination committee and firm performance, while there is a negative relationship between remuneration committee and firm performance. The positive relationship related to the nomination committee is due to higher independence of the board members in this committee. The presence of independent board members will help the company to achieve good corporate governance practices which will consequently enhance firm performance. They also have found that the ownership structure affects the results. The family ownership affects the relationship between board committees and firm performance negatively in Hong Kong since board committees in family businesses usually have family members or directors who are executives. The negative relationship related to remuneration committees is because “the monitoring function of remuneration committees would be weakened with the involvement of executive chairman who is usually from or related to the controlling family” (Lam and Lee, 2012: 363). In addition to that, remuneration committee has less independent members than nomination committee (Lam and Lee, 2012).

Hoque, Islam and Azam (2013) conducted a study to check if there is a relationship between the frequency of meeting of the board committees and the firm performance. They conducted their research on 118 Australian listed companies covering the period from 1999 to 2007. It was proved that some of the committees have effects on the firm performance while others do not. Firm performance, which is measured by ROA and return on equity (ROE), is affected by the frequency of meetings of the audit committee and remuneration committee but risk committee does not influence firm performance. The positive effect of the audit committee meetings is due to that this committee enhances performance of the companies by controlling financial risks through enhancing financial reporting. On the other hand, the positive results related to the remuneration committees is due to enhancing performance of the firm through increasing productivity because of securing higher compensations to managers.

In addition to that, they illustrated that there are factors that affect the frequency of board committee meetings. Board members are concerned about the firm performance since this would affect their reputation or committed and actively attend the board committee meetings or have chairman who is eager and requires frequent board committee meetings.

### **2.2.3 Number of independent board members and firm performance**

Another aspect that affects firm performance is the number of independent board members. Arosa, Iturralde and Maseda (2013) conducted a study on 307 small and medium sized companies in Spain. They concluded a negative relationship between number of independent board members and firm performance. They stated that inside directors contribute to better decisions because of their knowledge about the company's processes affecting firm performance positively. Singla and Singh (2019) conducted a study for the period from 2007 to 2016 in India. They used a sample of 3,854 firms to test the relationship between board monitoring and firm performance in India. They represented board monitoring by board independence and the independence of audit committee. They concluded that as the board independence increases, firm value (which is represented by Tobin's Q) decreases. Independence of board of directors may be affected by the following factors: "adverse selection process (such as the involvement of the CEO/promoters in the selection process); subtle linkages between the independent directors and the CEO or the company which are too subtle to come under the purview of the formal definition of an independent director; long tenure of the independent directors in the firms" (Singla and Singh, 2019: 8). Other factors that may contribute to this negative relationship are: sometimes they do not have enough experience about the business of the company, they are busy, and they do not have enough incentives. On the other hand, there is a positive relationship between independence of audit committee and firm value. Their findings were aligned with Klein's results (1998) since the independent directors are valuable when they are placed in the right committees (Singla and Singh, 2019). Rashid (2018) conducted a study to demonstrate the relationship between board independence and firm performance in Bangladesh using 135 companies. Although, it is known that the presence of independent members is better to boost shareholders' goals, it was found that there is no positive relationship between board independence and firm performance in

Bangladesh. The study stated that insiders are better because they have more valuable knowledge about the firm than the outside directors. In addition to that, there may be a relationship between the new outsiders who are recommended by insiders. In some cases, outsiders are not qualified enough because they do not have enough information about the firm as insiders have and most of them are not full-timers. Yasser, Mamun and Marcus (2017) conducted a study on companies in Pakistan listed on Karachi stock exchange to validate the relationship between board structure and firm performance. The study represented firm performance indicator by ROA, ROE and economic value added. It was concluded that there is a negative relation between independent board members and firm performance. This negative relationship may occur because there are no requirements that the independent director should have suitable qualifications and experience.

Ghasemi and Ab Razak (2016) have conducted a study in Malaysia from 2010 to 2013 using 267 listed companies to test the relationship between executive ratio and profitability of the firm. Executive ratio is “the ratio of the executive directors to total members on the board” (Ghasemi and Ab Razak, 2016: 3). In Malaysia, companies are motivated to have more independent board members, however, it was concluded that there was a positive relationship between number of executive and earning per share because they have knowledge and experience about the business processes of the firm (Ghasemi and Ab Razak, 2016).

There is another study which was conducted to test the relationship between independence of board of directors with the firm performance in Saudi Arabia. They used a sample of 329 non-financial listed firms for the years from 2013 to 2015 (Alshetwi, 2017). It was concluded that there is no relationship between independence and firm performance. They suggested that this relationship may be applicable in Saudi Arabia because “Saudi Arabia’s structure is influenced by societal norms that are heavily influenced by the tribal system and tribal values” (Alshetwi, 2017: 12). Then they did further tests that revealed that board independence may affect firm performance negatively in Saudi Arabia. This is because “in Saudi business context, non-executive members lack real independence from management and represent an additional cost burden that outweighs any benefits obtained from them” (Alshetwi, 2017:12). Johl, Kaur and Cooper (2015), concluded that there is no relationship between board independence and firm performance.

Ammari, Amdouni, Zemzem and Ellouze (2016) tested the French market by conducting a study from 2001 to 2013 using a sample of 80 listed companies. They used the two measures for dependent variables which are ROA (as an accounting measure for firm performance) and Tobin's Q (as a market measure for firm performance). They used interaction terms for board monitoring variables. These terms are: a monitoring committee indicator with board size and a monitoring committee indicator with board independence. The monitoring committee indicator takes the value of zero or one. It takes one if the number of monitoring committees are at least three. It was concluded that there is a negative relationship between independent board members and accounting performance if there are at least three committees. This negative impact on accounting performance is due to "the high costs incurred by the firm in the case of several committees adding to the independent directors' costs" (Ammari, Amdouni, Zemzem and Ellouze, 2016: 10).

There is another study that checks the relationship between board independence and firm performance. They used non-financial listed companies on FTSE 100 for the period from 2012 to 2015. The researchers concluded that there was a positive relationship between board independence and firm performance (represented by Tobin's Q) due to the mitigation of the agency theory conflicts because of the presence of more independent board members and consequently firm performance will improve (Alqatan, Chbib, Hussainey, 2019). Kaur and Vij (2017) concluded that having many independent members has no effect on efficient board. However, banks need to have independent members that have enough knowledge and skills to be able to help the executives to run the company well.

Arora (2012) examined the relationship between corporate governance and firm performance. This study was conducted in India covering the period between 2001 and 2010. It was concluded that the firm performance was enhanced when there are many inside directors on the board. "This relationship can also be attributed to the fact that the concept of board independence is a new phenomenon for Indian firms and so, it might take few more years to have a momentous impact on firm performance." (Arora, 2012: 547).

Alhussayen and Shabou (2016) conducted a study to examine the relationship between board monitoring and firm performance in Saudi Arabia between 2008 to

2013. The sample contains the listed companies on stock exchange in Saudi Arabia (excluding firms related to banking and insurance sectors). Firm value was represented by Tobin's Q and Market to book ratio (M-B ratio) and the board monitoring was represented by the board committees' independence. These committees are remuneration, nomination and audit committees. M-B ratio is calculated by dividing the market value of common stock by the book value of common stocks. They concluded that there is a positive relationship between board monitoring and firm value. They stated that these results show that board of directors is effective in Saudi Arabia in terms of their monitoring functions. They also suggested that monitoring provided by outside directors is better than monitoring provided by inside directors as "the outside board members provide the required monitoring over the firm's managers and controlling shareholders and prevent them from misusing the firm's resources" (Alhussayen and Shabou, 2016: 149)

Klein (1998) examined whether there is a relationship between board committee structure and firm performance by using a sample of S&P 500 companies. Klein found that if the board composition was illustrated by dividing the board members into insiders (currently employed by the firm), outsiders and affiliates (they can be relatives of the CEO, were employed by the firm but they are no longer employees of the firm, they have business relationship with the company), there will be no relationship between the firm performance and board composition. On the other hand, "Board composition has marginal explanatory value for various performance measure" (Klein, 1998: 300). The study examines the roles of the board members on different board committees. It was found that there is a positive relationship between the existence of many insiders in the investment and finance committee and firm performance. It was also proved that a company experiences abnormal stock returns if they increased the number of inside board members on their finance and investment committees. The positive results associated with the presence of insiders are due to their valuable knowledge about the business activities (Klein, 1998).

Arora and Sharma (2016) concluded that independence of board of directors affect firm performance negatively. This negative relationship may be because board independence is unfamiliar concept in developing countries, accordingly it will take time to positively influence firm performance.

#### **2.2.4 Board size and firm performance**

Board size affects firm performance. Ghasemi and Ab Razak (2016) proved that there is a positive relationship between the board size and firm profitability because the large board size gives more strategic information and increases business connections. Alshetwi (2017) concluded that there is no relationship between board size and firm performance of non-financial firms in Saudi. Kalsie and Shrivastav (2016) conducted a study that measures the relationship between board size and firm performance in India. They used a sample 145 companies covering the period from 2008 to 2012. They used ROA, Tobin's Q, Market to book value ratio (MBVR) and return on capital employed (ROCE) as measures for firm performance. They concluded that there is a positive relationship between board size and firm performance. They believed that the positive results of this study support agency theory and resource dependency theory. These theories will be discussed later.

Johl, Kaur and Cooper (2015) concluded that the larger board size can better monitor the management and consequently enhance firm performance. Ammari, Amdouni, Zemzem and Ellouze (2016) tested the French market and concluded that there is a negative relationship between large board size and market performance. When the board size increases, decisions are not appropriately made because of the coordination problems they face which consequently affects performance. However, there is a positive relationship between board size and accounting performance if there are at least three committees. The presence of the committees helps the large board size to achieve its goals, since the key role of these committees is to solve coordination issues and make sure that all members receive the same information (asymmetric information). Alqatan, Chbib, Hussainey (2019) concluded there is a positive relationship between board size and firm performance when using ROA as a measure of firm performance. The large board size leads to better decision making due to more ideas will be generated which will finally enhance firm performance.

Kaur and Vij (2017) concluded that there is a positive relationship between small board size and firm performance. Board size has a negative relationship with firm performance due to the difficulty the board face for organization, communication and making decisions when they have large board size which ultimately affects firm performance.



Arora (2012) showed that there is a positive relationship between board size and firm performance if they used Tobin's Q as measure of firm performance. Tobin's Q is enhanced by having large board size, since the firm will have more qualifications and experience which will enhance decision making. However, there is a negative relation between them when Arora used ROA as firm performance indicator. Arora justified that this negative relationship, which is different from other studies' findings, may be because this study is conducted specifically for pharmaceutical industry. It was also proved that there is a positive relationship between number of board meetings and firm performance by using both measures ROA and Tobin's Q. The positive results associated with large board size and increase in the number of meetings are due to collective experience and knowledge which lead to better decision making and improved firm performance.

There was a study conducted in Pakistan to test the relationship between corporate governance and firm performance. The period covered was from 2010 to 2014 using 80 non-financial firms in Pakistan. They concluded that there is a positive relationship between board size and firm performance. They believed that these results are aligned with the resource dependence theory. (Muhammad, Rehman, Waqas, 2016).

Yasser, Mamun and Marcus (2017) concluded there was a positive relationship between board size and firm performance because as the board size increases, monitoring activity increases, because of the various experiences of the board members which will consequently enhances the firm performance.

Arora and Sharma (2016) concluded that there is a negative relationship between board size and ROA. They believed that this negative relationship is due to the difficulty in communication, coordination and the free riding issues associated with the increase in the number of board of directors.

### **2.3 Theories**

There are numerous theories that deal with the relationship between board of directors and firm performance. These theories are agency theory, resource dependency theory and stewardship theory. As previously mentioned *agency theory* interprets the relationship between principal and agent. This theory states that large board size is better for firm performance because board of directors will work towards the interests

of the shareholders and consequently enhance firm performance. *Resource dependency theory* deals with the behavior change of the organization to utilize external resources. This theory stated that larger board size is better since more experience in different fields will be available for the firm and consequently enhance its performance. On the other hand, another theory that favors small board size is the stewardship theory (Kalsie and Shrivastav, 2016). “*The stewardship theory* documents that the managers, when left on their own, act as responsible stewards of the assets they control” (Kalsie and Shrivastav, 2016: 149). This theory supports that the managers do not need to be monitored by large board size and a small board is enough to monitor their performance (Kalsie and Shrivastav, 2016). Makhoulouf, Laili, Basah and Ramli (2017) stated that according to previous research, two theories are related to the relationship between board of directors and firm performance which are the agency theory and resource dependency theory. *Agency theory* states that the key role of the board of directors is to monitor the management and to mitigate the conflicts between the management of the company and the shareholders because of their different interests. On the other hand, *resource dependency theory* suggests that the board of directors are considered as resources for the firm. They could improve its performance through providing the firm with expertise, maintain good external relationships and give advice to the management of the company. *Agency theory* suggests that there is a positive relationship between independent board of directors and firm performance since they will monitor the management without prejudice and provide the firm with their expertise in different areas. In terms of board size, *agency theory* states that there is a negative relationship between board size and firm performance. Smaller size is better because as board size increases, difficulty in decision making process will also increase because of the complexity to make large board size agree on the same decision (Makhoulouf, Laili, Basah and Ramli, 2017). There is conflict between the findings of Makhoulouf, Laili, Basah and Ramli’s and Kalsie and Shrivastav’s research regarding the agency theory and its relation with board size. Makhoulouf, Laili, Basah and Ramli (2017) states that *resource dependency theory* supports a positive relationship between board size and firm performance since the presence of large board size from various backgrounds enhances decision making and consequently improves firm performance. Regarding frequency of board meetings, *agency theory* states that increasing the number of board meetings is better, since monitoring will improve which enhances the firm performance. On the other hand, *stewardship theory* suggests that the relationship between number of board

meetings and firm performance may be negative because “the board of directors’ meetings are irrelevant to the implementation of a board’s governance obligations because monitoring is an entirely endogenous process” (Makhlouf, Laili, Basah and Ramli, 2017: 25).

## **2.4 Summary of the literature review**

Appendix 1 summarizes the studies that were covered in the previous literature review section. These studies focus on measuring the relationship between board monitoring and firm performance.

## **3. Research methodology**

### **3.1 Sample size and data**

This thesis measures the relationship between board monitoring (independent variable) and firm performance (dependent variable). The sample size is based on the Financial Times and London Stock Exchange (FTSE) top 150 listed companies for the period from 2013 to 2017. FTSE includes the largest listed companies on London Stock Exchange (LSE). It manages Exchange traded funds (ETF), bonds, derivatives and international equity (London Stock Exchange Group, 2018). The most popular index is FTSE 100. However, there are also FTSE 150 and FTSE 250. This thesis focuses on FTSE 150 which includes the largest 150 listed companies on LSE (FTSE, 2018). FTSE 150 is used in this thesis based on the availability of governance data related to board members. FTSE index was designed to signify the performance of companies in the UK which helps investors to comprehend the performance of the UK equity market (FTSE Statistics, 2018).

The board data is from Spencer and Stuart which is a big consulting firm that has 60 years of experience. It provides insights about how to select, evaluate and increase the effectiveness of executives. It focuses on providing information about key elements of boards which play an essential role in corporate governance trends. It formulates a board index which explores the trends and the challenges facing boards in various corporations. Examples of the most recent board index reports were: 2018 US Spencer Stuart board index, 2018 Spain Spencer Stuart board index and 2018 France

Spencer Stuart Board Index (Board Governance Trends: A Global View, 2018). The financial data is from Thomson Reuters database and the audit type data is from S&P Capital IQ database.

### 3.2 Model

The dependent variable is the firm performance which is measured by Tobin's Q (Total market value of the firm divided by total asset value of the firm) and return on assets (ROA)<sup>1</sup>. This thesis uses ROA as an accounting measure and Tobin's Q as market performance measure. Tobin's Q gives indication about the market value of the firm. The independent variables are the number of board meetings and number of board committees. Control variables are: number of independent board members, board size, company size, leverage, sector/industry and audit type. R software is used in the analysis.

Accordingly, this thesis focuses on testing two models. The first model includes the first dependent variable (ROA) with all independent and control variables. The second model includes the second dependent variable (Tobin's Q) with all independent and control variables. The below equations are used to examine the two models:

$$Y_{it1} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_{3:8} X_{3:8} + \varepsilon_{it}$$

$$Y_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_{3:8} X_{3:8} + \varepsilon_{it}$$

Where:

$Y_{it1}$  = ROA (Net income/Average total assets)

$Y_{it2}$  = Tobin's Q (Total market value of firm/Total asset value of firm)

$X_{1:2}$  = Independent variables (discussed in Table 1)

$X_{3:8}$  = Control variables (discussed in Table 1)

$\beta_0$  = Intercept.

$\beta_{1:8}$  = Regression model coefficients.

$\varepsilon_{it}$  = Error term.

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<sup>1</sup> ROE was tested but the results were insignificant.

**Table 1: Definition of independent variables**

<b>Category</b>	<b>X</b>	<b>Variable</b>	<b>Variable name</b>	<b>Calculation</b>	<b>Source</b>
<b>Board variable</b>	$X_1$	Number of board meetings	nmeeting	N/A	Spencer and stuart
	$X_2$	Number of board committees	Nbcom	N/A	Spencer and stuart
<b>Control Variable</b>	$X_3$	Number of independent board members	Nib	N/A	Spencer and stuart
	$X_4$	Board size	Board size	N/A	Spencer and stuart
	$X_5$	Company size	Employees	Number of employees	Thomson Reuters
	$X_6$	Leverage	Leverage	Total debt % /Common Equity	Thomson Reuters
	$X_7$	Sector / Industry	Industry	1= financial services sector 0=non-financial services sector	Thomson Reuters
	$X_8$	Audit type	Audit	1 = audited by one of the Big- four 0= not audited by one of the Big -four	S&P capital IQ

## 4. Results

### 4.1 Descriptive statistics

Table 2 shows the descriptive statistics for the data which shows the mean, standard deviation, minimum, maximum and number of observation. The average value for ROA is 9.645 with a maximum of 269.11 and a minimum of -21.58. The average value for Tobin's Q is 0.002 with a maximum of 0.071 and a minimum of 0.00001. The average number of board meetings is 8 meetings with a minimum of 2 meetings and a maximum of 23 meetings. In terms of board committees, they have average of approximately 4 committees. The maximum number is 7 committees while the minimum is 3 committees. The average number of independent board members is 6 with a maximum of 15 and a minimum of 2. While the average board size is 10 members with a maximum of 20 and minimum of 5. The average number of employees is 42,128 employees.

**Table 2: Descriptive statistics**

<b>Statistic</b>	<b>Mean</b>	<b>St. Dev.</b>	<b>Min</b>	<b>Max</b>	<b>N</b>
<b>ROA</b>	9.645	22.296	-21.580	269.11	698
<b>Tobin's Q</b>	0.002	0.005	0.00001	0.071	734
<b>Nbmeeting</b>	8.167	2.498	2	23	744
<b>Nbcom</b>	3.801	0.866	3	7	745
<b>Nib</b>	6.181	2.021	2	15	745
<b>Board size</b>	10.254	2.317	5	20	745
<b>Employees</b>	42,128	83,990	12	631,465	738

### 4.2 Correlation

#### 4.2.1 Pearson correlation

Table 3 shows Pearson correlation coefficient matrix for the sample. The correlation matrix shows that there is a negative correlation between ROA and leverage and number of board meetings. There is a significant negative correlation between ROA and number of board committees, number of independent board members, board size and number of employees. There is a negative correlation between Tobin's Q and number of board meetings, number of employees and leverage. There is a significant negative correlation between Tobin's Q and number of board committees, number of independent board members and board size. The correlation matrix also shows that

there is a strong positive correlation between number of board committees and number of board meetings, number of independent, board size and number of employees.

**Table 3: Pearson Correlation Coefficient matrix**

		nbmeeting	nbcom	nib	Board size	ROA	Tobin's Q	employees	leverage
nbmeeting	Pearson Correlation	1							
	Sig. (2-tailed)								
	N	744							
nbcom	Pearson Correlation	.177**	1						
	Sig. (2-tailed)	0.000							
	N	744	745						
nib	Pearson Correlation	.074*	.399**	1					
	Sig. (2-tailed)	0.045	0.000						
	N	744	745	745					
board_size	Pearson Correlation	0.042	.312**	.831**	1				
	Sig. (2-tailed)	0.254	0.000	0.000					
	N	744	745	745	745				
ROA	Pearson Correlation	-0.044	-.157**	-.126**	-.121**	1			
	Sig. (2-tailed)	0.245	0.000	0.001	0.001				
	N	697	698	698	698	698			
Tobin's Q	Pearson Correlation	-0.020	-.156**	-.118**	-.110**	.959*	1		
	Sig. (2-tailed)	0.595	0.000	0.001	0.003	0.000			
	N	733	734	734	734	693	734		
employees	Pearson Correlation	0.057	.213**	.261**	.187**	-.093*	-0.070	1	
	Sig. (2-tailed)	0.126	0.000	0.000	0.000	0.015	0.060		
	N	728	728	728	728	685	721	728	
leverage	Pearson Correlation	0.042	-0.039	0.004	0.010	-0.018	-0.026	0.004	1
	Sig. (2-tailed)	0.257	0.300	0.907	0.792	0.644	0.493	0.909	
	N	714	715	715	715	676	712	706	715

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

### 4.2.2 Chi-Square test

The two variables: audit and industry are categorical variables. Accordingly, correlation test was carried out to examine them. The relevant test is the Chi-Square test. Two hypotheses were formulated to be tested as shown in the below equations:

$$H_0 = \text{audit and industry are independent}$$
$$H_1 = \text{audit and industry are not independent}$$

The Pearson's Chi-squared test with Yates' continuity correction shows that x-squared is 0.097654, the degrees of freedom equals to 1 and p-value equals to 0.7547. The results show that as the p-value is greater than 0.05 so we cannot reject the null hypothesis which means that audit and industry are independent.

### 4.3 Results of model 1

In the first model, the relationship between board monitoring and firm performance (represented by ROA) was examined as shown in the below equation<sup>2</sup>:

$$ROA = \beta_0 + \beta_1 nbmeeting + \beta_2 nbcom + \beta_3 nib$$
$$+ \beta_4 board\ size + \beta_5 employees + \beta_6 leverage + \beta_7 industry$$
$$+ \beta_8 audit + \varepsilon_{it}$$

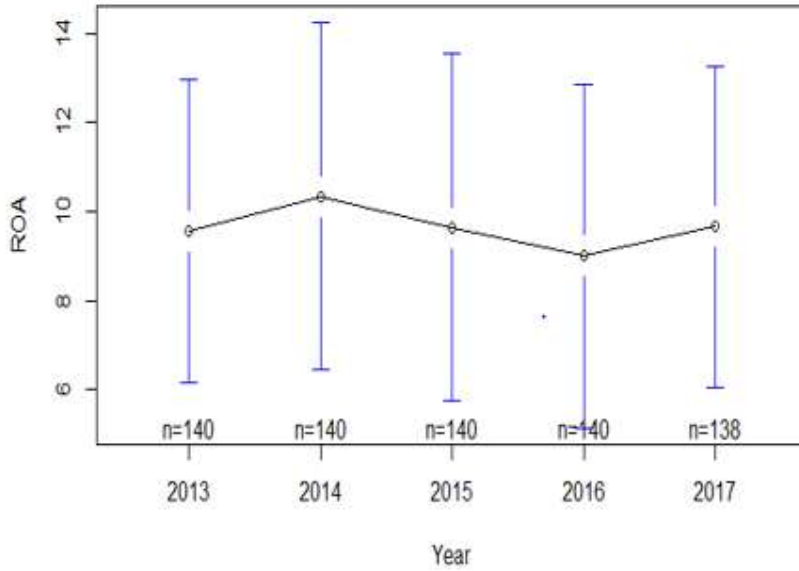
Where the definitions of the variables were provided in Table 1.

Firstly, the heterogeneity was examined to check if the selected sample has some differences across the companies and time. Means are almost the same across years as shown in Figure 1. However, ROA does not have equal means across different companies. Few companies were different from the rest (almost all the companies have the same average) as shown in Figure 2. Accordingly, these figures suggest the use of panel data to incorporate the effects of different companies on the ROA.

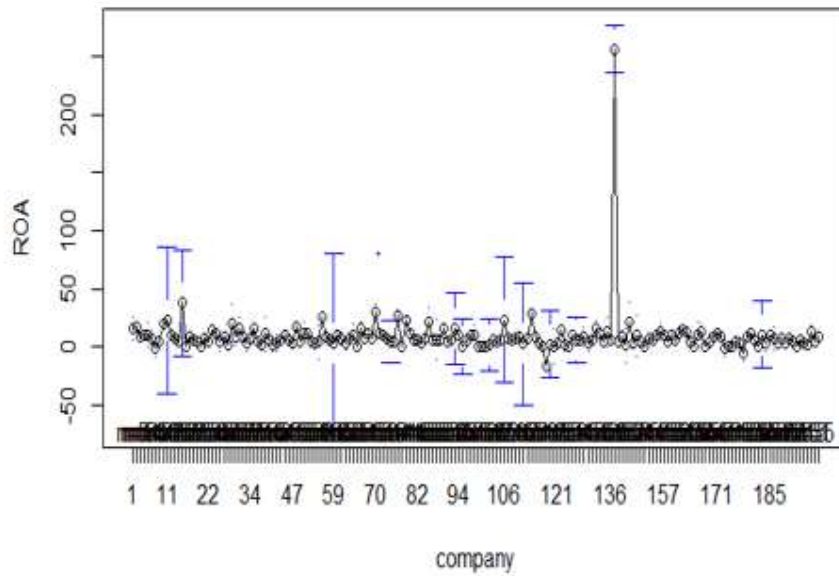
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<sup>2</sup> There was no multicollinearity between variables.





**Figure 1. Heterogeneity across years in terms of ROA.**



**Figure 2. Heterogeneity across companies in terms of ROA.**

Different models were examined to reach the best model. Time effect was ignored in the first trial. On the other hand, companies' effects were taken into consideration as shown in Appendix 2. The results of the first trial shows that companies are significant and have influence on ROA. The second trial was incorporating time effect into the model. The time was insignificant (as shown in

Appendix 3), so time can be ignored in the model. Another model was examined which is OLS. It was used to ignore time and companies' effect (refer to Appendix 4) showing that the significant variables are number of board committees and leverage. The results of the three trials show that time does not have an effect, however companies have influence on ROA. Accordingly, fixed model was used to incorporate the companies as factors to check for the individual fixed effects (companies' effects) (as shown in Appendix 5). F test also was carried out to check if fixed model or ordinary least squares (OLS) was better (as shown in Appendix 6), and the conclusion was that fixed model is better since the p-value was less than 0.05. Backward elimination method was used to reach to the best model. Backward elimination is a process in which insignificant variables will be removed gradually until the best model will be reached with the significant variables. Accordingly, insignificant variables were removed gradually until we reach the best model to measure the effect of the independent variables on ROA. The first model that includes all the independent variables (before using the backward elimination method) was as shown in Table 4.

**Table 4: Fixed model results with ROA**

Unbalanced Panel: n = 180, T = 1-5, N = 681				
Observations used in estimation: 180				
Residuals:				
Min.	1st Qu.	Median	3rd Qu.	Max.
-30.32926	-5.40913	-0.75183	3.17023	234.92089
Coefficients:				
	Estimate	Std. Error	t-value	Pr(> t )
Intercept	34.7302771	14.0002955	2.4807	0.014080 *
Audit	3.0091357	10.9208493	0.2755	0.783234
board size	-1.1867578	1.2963523	-0.9155	0.361240
Industry	-1.8909339	4.0937127	-0.4619	0.644732
Leverage	-0.0261351	0.0083903	-3.1149	0.002158 **
Nbcom	-3.4809019	2.2503888	-1.5468	0.123760
Employees	0.0082303	0.0075488	1.0903	0.277126
Nib	0.7199976	1.5532249	0.4636	0.643560
nbmeeting	-0.2955304	0.7341947	-0.4025	0.687802
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Total Sum of Squares: 68979				
Residual Sum of Squares: 62810				
R-Squared: 0.089422				
Adj. R-Squared: 0.046822				
F-statistic: 2.09911 on 8 and 171 DF, p-value: 0.038333				

P-value was less than 0.05 so the model is significant. In this model, leverage was a significant variable. Also, there is a negative association between number of board meetings and number of board committees with ROA. By applying the backward elimination method to remove the insignificant variables and reach the best model. The results were as shown in Table 5.

**Table 5: Fixed model results with ROA after applying backward elimination**

Unbalanced Panel: n = 182, T = 1-5, N = 698				
Observations used in estimation: 182				
Residuals:				
Min.	1st Qu.	Median	3rd Qu.	Max.
-31.91714	-5.55019	-0.79087	2.71896	235.83527
Coefficients:				
	Estimate	Std. Error	t-value	Pr(> t )
Intercept	33.277456 1	7.4572416	4.4624	1.43e-05 ***
Leverage	-0.025363 0	0.0080061	-3.1680	0.001805 **
Nbcom	-4.316923 5	1.8398920	-2.3463	0.020056 *
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Total Sum of Squares: 68982				
Residual Sum of Squares: 63578				
R-Squared: 0.07833				
Adj. R-Squared: 0.068032				
F-statistic: 7.60631 on 2 and 179 DF, p-value: 0.00067533				

P-value was less than 0.05 which makes the model significant. The significant variables were number of board committees and leverage. The results show that by using ROA, there is no significant relationship between number of board meetings and firm performance but there is a negative significant relationship between number of board committees and firm performance. This means that as number of board committees and leverage increase, ROA decreases. Based on the results of Pearson correlation matrix, there is a positive association between number of board committees and board size which means that as the number of board committees increases, board size increases. Accordingly, the negative relationship associated with increase in the number of board committees is consistent with Bachiller, Giorgino and Paternostro's

(2014) and Kaur and Vij's (2017) findings. They believed that increasing board size negatively affects firm performance because of the concept of free riders. Also, Arora and Sharma (2016) believed that there is a negative relationship between board size and ROA because of difficulty in communication, coordination and the free riding issues. In addition to that, this negative relationship may be due to the appointment of directors who are busy outside directors (holding more than one directorship). Fich and Shivdasani (2006) stated that busy directors are more likely to result in weak governance which consequently affects the firm performance negatively. Busy directors will not be able to effectively monitor the performance of the firm because they will be unfocused, and monitoring activity will decline.

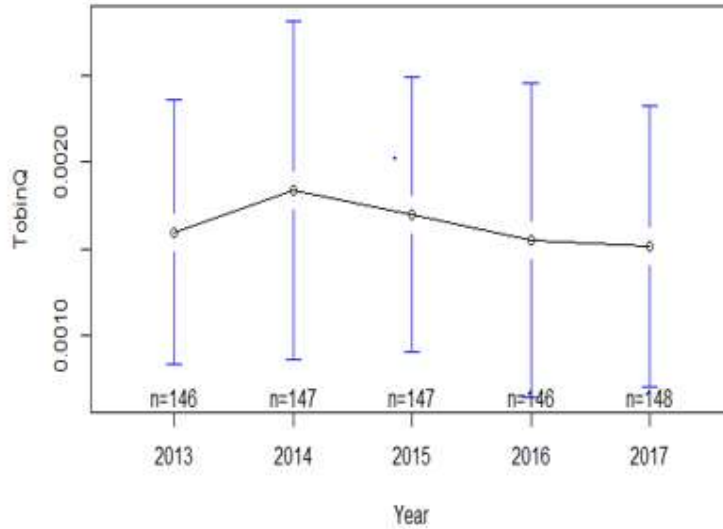
#### 4.4 Results of model 2

In the second model, the relationship between board monitoring and firm performance (represented by Tobin's Q) was examined as shown in the below equation:

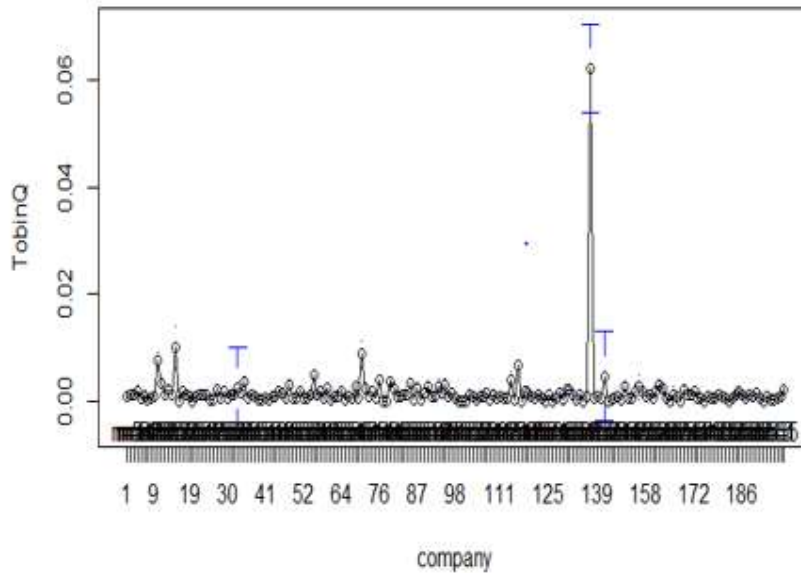
$$\begin{aligned} \text{Tobin's } Q = & \beta_0 + \beta_1 \text{ nbmeeting} + \beta_2 \text{ nbcom} + \beta_3 \text{ nib} \\ & + \beta_4 \text{ board size} + \beta_5 \text{ employees} + \beta_6 \text{ leverage} + \beta_7 \text{ industry} \\ & + \beta_8 \text{ audit} + \varepsilon_{it} \end{aligned}$$

Where the definitions of the variables were provided in Table 1.

Firstly, the heterogeneity across the companies and time was examined. Figure 3 show that means are almost the same across years. However, Tobin's Q does not have equal means across different companies. Few companies are different from the rest as shown in Figure 4. Accordingly, panel data was suggested to be used to incorporate the effects of different companies on Tobin's Q.



**Figure 3: Heterogeneity across years in terms of Tobin's Q.**



**Figure 4. Heterogeneity across companies in terms of Tobin's Q.**

Different models were examined to reach the best model with Tobin's Q. Time effect was ignored in the first trial and companies' effect were considered. Accordingly, it was found that companies influence Tobin's Q (as shown in Appendix 7). The second trial was incorporating time effect into the model. The time was insignificant (as shown in Appendix 8). OLS was used to ignore both time and companies' effect (refer to

Appendix 9). The results of the three trials show that time does not have an effect, however companies have influence on Tobin's Q. Accordingly, fixed model was used to incorporate the companies as factors check for the individual fixed (Appendix 10). F test also was carried out to check if fixed model or ordinary least squares was better (as shown in Appendix 11), and the conclusion was that fixed model is better since the p-value was less than 0.05. Then backward elimination technique was used to reach the best model (as discussed in the previous section). The first model that includes all the independent variables (before using the backward elimination method) are as shown in Table 6.

**Table 6: Fixed model results with Tobin's Q**

Unbalanced Panel: n = 188, T = 1-5, N = 716				
Observations used in estimation: 188				
Residuals:				
Min.	1st Qu.	Median	3rd Qu.	Max.
-0.00321954	-0.00134079	-0.00034736	0.00050149	0.05775967
Coefficients:				
	Estimate	Std. Error	t-value	Pr(> t )
Intercept	6.1709e-03	3.3011e-03	1.8693	0.063212
Audit	4.9796e-04	2.5953e-03	0.1919	0.848060
board size	-1.5570e-04	3.0414e-04	-0.5119	0.609330
Industry	-6.7251e-04	9.0663e-04	-0.7418	0.459200
Leverage	-5.8296e-06	1.9640e-06	-2.9682	0.003405 **
Nbcom	-9.2654e-04	5.1444e-04	-1.8011	0.073377
Employees	2.0074e-06	1.7668e-06	1.1362	0.257400
Nib	8.3892e-05	3.6113e-04	0.2323	0.816566
nbmeeting	9.0999e-05	1.7099e-04	0.5322	0.595259
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Total Sum of Squares: 0.0040475				
Residual Sum of Squares: 0.0037148				
R-Squared: 0.082192				
Adj. R-Squared: 0.041173				
F-statistic: 2.00374 on 8 and 179 DF, p-value: 0.04837				

P-value was less than 0.05 so the model is significant. The significant variable was leverage. Also, there is a positive relationship between number of board meetings and firm performance. On the other hand, there is a negative relationship between number of board committees and firm performance. The relationship between number of board meetings and firm performance differed based on the measure of firm

performance which was used. By using ROA, the relationship was negative while the relationship was positive by using Tobin's Q. Then the backward elimination method was used to remove the insignificant variables and reach the best model. The results are as shown in Table 7.

**Table 7: Fixed model results with Tobin's Q after applying backward elimination**

Unbalanced Panel: n = 191, T = 1-5, N = 734				
Observations used in estimation: 191				
Residuals:				
Min.	1st Qu.	Median	3rd Qu.	Max.
-0.00307041	-0.00121801	-0.00028878	0.00045478	0.05821628
Coefficients:				
	Estimate	Std. Error	t-value	Pr(> t )
Intercept	7.1256e-03	1.7044e-03	4.1806	4.452e-05 ***
Leverage	-5.2601e-06	1.8529e-06	-2.8389	0.005024 **
Nbcom	-1.0341e-03	4.1406e-04	-2.4974	0.013370 *
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Total Sum of Squares: 0.0040506				
Residual Sum of Squares: 0.0037723				
R-Squared: 0.068714				
Adj. R-Squared: 0.058807				
F-statistic: 6.93572 on 2 and 188 DF, p-value: 0.0012411				

P-value was less than 0.05 which makes the model significant. The variables which are significant in this model were number of board committees and leverage. The results suggest that there is no significant relationship between number of board meetings and firm performance but there is a negative significant relationship between number of board committees and firm performance (Tobin's Q). This means that as number of board committees and leverage decreases, Tobin's Q increases. Based on the results of Pearson correlation matrix, there is a positive association between number of board committees and board size. Accordingly, the negative relationship between number of board committees and firm performance is consistent with Ammari, Amdouni, Zemzem and Ellouze's (2016) findings that support a negative relationship between board size and market performance measure (Tobin's Q) because as the board

size increases, firm performance decreases, because of the coordination problems which affects the ability of the board members to make proper decisions.

## **5. Conclusion**

Corporate governance is an essential pillar for companies. There are several definitions of corporate governance. This thesis focused on the definition in which corporate governance is “a set of predefined rules which guide the actions of managers resulting in the best interest of investors” (Srivastava, Das and Pattanayak, 2018: 2). One of the principles of corporate governance is board of directors and their roles (OECD Principles of Corporate Governance, 2015). Board of directors is a mechanism that is used to mitigate conflicts between shareholders and management. Various aspects regarding the board of directors were covered by previous research such as board diversity and board structure. There are few research studies about number of board committees and firm performance.

Previous studies tried to test if there was a relationship between board of directors and the firm performance. This thesis examined the relationship between board monitoring and firm performance. Board monitoring was measured by the number of board meetings and number of board committees. Firm performance was measured by an accounting measure (ROA) and market performance measure (Tobin's Q). The sample was FTSE 150 for the years from 2013 to 2017. Control variables were: number of independent board members, board size, leverage, audit, industry and number of employees. The results showed that there was no significant relationship between number of board meetings and firm performance. There was a negative association between number of board meetings and ROA but there was a positive relationship between number of board meetings and Tobin's Q. However, there was a significant negative relationship between number of board committees and firm performance (by using ROA and Tobin's Q). In addition to that, there was a positive association between number of board committees and board size. Accordingly, as the number of board committees increases, board size increases. This suggested that the negative relationship between number of board committees and firm performance may be due the increase in board size which leads the coordination, communication and free-riders problems that hindered the board of directors to monitor the management properly and consequently affected the firm performance negatively. The negative



relationship implies that number of board meetings and number of board committees are not as important as the capabilities of the board members to apply rules and procedures to achieve good corporate governance practices and consequently enhance firm performance. Further research could add other board of directors' characteristics such as: level of education, CEO tenure, CFO tenure and CEO duality. There was a limitation on the level of education of the board of directors since there is no available data on previous board members qualifications.

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## List of appendices

### Appendix 1: Summary of the literature review

The following Table summarizes the studies that were covered in the previous literature review section. These studies focus to measure the relationship between board monitoring and firm performance.

<b>Study</b>	<b>Years</b>	<b>Country</b>	<b>Dependent variables</b>	<b>Independent variables</b>	<b>Results</b>
Brick and Chidambaran (2010)	1999 to 2005	United States of America	ROA, Tobin's Q and price per share (PPS)	-logarithm of board meetings - logarithm of the product of annual board meetings and number of independent board members -Independence of board members -Duality of the CEO	-Board monitoring is positively affecting the firm value

Chou, Chung and Yin (2013)	2006 and 2007	Taiwan	-ROA, EPS (earning per share), Sales to assets ratio, Sales growth rate	-Percentage of board meetings attended by a director himself/herself -Percentage of meetings attended by the authorized representatives of the director”	-Positive effect: if board of directors attend the meetings by themselves - Negative effect: if they authorize representatives to attend the meeting on behalf of them.
Arora and Sharma (2016)	2001 to 2010	India	ROA, ROE, net profit margin (NPM), Tobin’s Q, Stock returns (SR)	-Board size -Board meeting frequency -Outside directors.	-Positive effect: between the frequency of board meetings and firm performance. -Negative effect: between board size and return on assets, between Independence of board of directors and firm performance
Ntim and Osei (2011)	2002-2007	South Africa	Tobin’s Q, ROA, TSR (Total shareholder return)	-Number of board meetings, Natural log of the total number of board meetings in a year)	-High frequency of board meetings leads to high corporate performance

Klein (1998)	1992 and 1993	United States of America (Companies listed on S&P 500)	ROA, Jensen productivity (It is equal to the change in market value of equity minus a benchmark return on investment), Market returns	-Board committee structure	- No relationship: between the firm performance and board composition. - Board composition has marginal explanatory value for various performance measure
Hoque, Islam and Azam (2013)	1999 to 2007	Australia	ROE, ROA	-Different board committees meetings' frequency	- It was proved that some of the committees have effects on the firm performance while others do not
Ebenezer (2017)	2008 to 2014	Nigeria and Ghana	-ROA, Tobin's Q	-Board meetings frequency	-A Positive relationship: between the intensity of board monitoring and firm performance
Alhussayen and Shabou (2016)	2008 to 2013	Saudi Arabia	-Tobin's Q, M-B ratio	- Board committees' independence	- A Positive relationship: between board monitoring and firm value.
Al-Daoud, Saidin, Abidin (2016)	2009 to 2013	Amman	-Tobin's Q, ROA	-Frequency of board meetings	- A Positive relationship: between frequency of board meetings and firm performance



Eluyela, Akintimehin,okere, Ozordi, Osuma, Ilogho and Oladipo (2018)	2011 to 2016	Nigeria	Tobin's Q	-Number of board meetings	- A Positive relationship: between the number of board meetings and firm performance
Arosa, Iturralde and Maseda (2013)	2006	Spain	-ROA	Board size, Number of board meetings	- A Negative relationship: between number of independent board members and firm performance -A Negative relationship: between board size and firm performance.
Singla and Singh (2019)	2007 to 2016	India	Tobin's Q	- board independence and the independence of audit committee	-A Negative relationship: between board independence and firm performance -A Positive relationship: between independence of audit committee and firm value
Rashid (2018)	2006-2011	Bangladesh	-Tobin's Q, ROA	-Board independence	- No positive relationship: between board independence and firm performance

Yasser, Mamun and Marcus (2017)	2009 to 2013	Pakistan	-ROA,ROE ,Economic value added	-Number of independent members - Board size	-A Positive relationship: between board size and firm performance. -A Negative relationship: between independent board members and firm performance
Lam and Lee (2012)	2001 to 2003	Hong Kong	-ROA, ROE, return on capital employed (ROCE), market-to-book value of equity(MTBV)	-Board committees (the presence of remuneration committee and the presence of nomination committee)	- A Negative relationship: between remuneration committee and firm performance. - A Positive relationship: between nomination committee and firm performance
Ghasemi and Ab Razak (2016)	2010 to 2013	Malaysia	-Earning per share	-Board size -Executive ratio is (the ratio of the executive directors to total members on the board)	- A Positive relationship: between the board size ad firm profitability - A Positive relationship: between number of executive and earning per share
Alshetwi (2017)	2013 to 2015	Saudi Arabia	-ROA	-Board size -Board independence	- A Negative relationship: between board independence and firm performance - No relationship :between board size and firm

Kalsie and Shrivastav (2016)	2008 to 2012	India	-ROA, Tobin's Q, - Market to book value ratio (MBVR), return on capital employed (ROCE)	-Board size	- A Positive relationship: between board size and firm performance.
Johl, Kaur and Cooper (2015)	2009	Malaysia	-ROA	-Board meetings, board size, board independence and experience of board of directors in accounting	-No relationship: between board independence and firm performance – A Positive relationship: between experience of board of directors in accounting, board size and firm performance
Ammari, Amdouni, Zemzem and Ellouze (2016)	2001 to 2013	France	-ROA, Tobin's Q	-Monitoring committee indicator with board size -Monitoring committee indicator with board independence	-A Negative relationship: between large board size and market performance. - A Positive relationship: between board size and accounting performance if there are at least three committees. -A Negative relationship: between large number of independent board members and accounting performance if there are at least three committees

Alqatan,Chbib, Hussainey (2019)	2012 to 2015	United Kingdom	-ROA, Tobin's Q	-Board independence -Board size -Board remuneration	-A Positive relationship: between board size and firm performance, between board remuneration and firm performance, between board independence and firm performance
Kaur and Vij (2017)	2008 to 2014	India	-ROA, Tobin's Q, Net interest income, ROE	-Independent members -Board size -frequency of board meetings -Number of females director - "percentage of meetings attended by the board of directors"	-A Positive relationship: between small board size, more female members on the board, high numbers of board meetings and firm performance.

Arora (2012)	2001 to 2010	India	-ROA, Tobin's Q	<ul style="list-style-type: none"> <li>-Number of board meetings</li> <li>-Board size</li> <li>-Outside board members</li> </ul>	<ul style="list-style-type: none"> <li>-A Positive relationship: between board size and firm performance if they used Tobin Q as measure of firm performance.</li> <li>-A Negative relationship: between board size and firm performance when they used ROA as firm performance indicator.</li> <li>-A Positive relationship: between inside directors and firm performance, between number of board meetings and firm performance</li> </ul>
Muhammad, Rehman, Waqas (2016)	2010 to 2014	Pakistan	-ROA, ROE	<ul style="list-style-type: none"> <li>-Board composition - Board size</li> <li>- CEO duality</li> <li>-Presence of audit committee</li> </ul>	<ul style="list-style-type: none"> <li>-A Positive relationship: between board size and firm performance</li> <li>-A Negative relationship: between CEO duality, board composition and firm performance</li> <li>-A Positive relationship between audit committee and firm performance</li> </ul>

## Appendix 2: ROA output without time effect

The following output shows the results for ROA ignoring time effect.

summary(olswt)

Call:

```
lm(formula = ROA ~ +as.numeric(Audit) + (as.numeric(board_size)) +  
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
  as.numeric(employees) + as.factor(company) + as.numeric(nib) +  
  as.numeric(nbmeeting), data = mydata)
```

Residuals:

Min	1Q	Median	3Q	Max
-26.168	-1.293	0.000	1.397	40.868

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	2.327e+01	1.132e+01	2.056	0.040302 *
as.numeric(Audit)	-1.112e+00	8.359e+00	-0.133	0.894194
as.numeric(board_size)	4.002e-01	3.824e-01	1.046	0.295850
as.factor(industry)1	-1.127e+00	3.350e+00	-0.337	0.736569
as.numeric(leverage)	5.127e-04	1.660e-03	0.309	0.757522
as.numeric(nbcom)	-9.520e-01	7.764e-01	-1.226	0.220703
as.numeric(employees)	-9.171e-04	2.126e-03	-0.431	0.666366
as.factor(company)2	1.258e+00	6.017e+00	0.209	0.834514
as.factor(company)3	-6.650e+00	3.538e+00	-1.879	0.060770 .
as.factor(company)4	-7.991e+00	5.036e+00	-1.587	0.113188
as.factor(company)5	-5.752e+00	3.738e+00	-1.539	0.124520
as.factor(company)6	-1.087e+01	5.208e+00	-2.087	0.037439 *
as.factor(company)8	-1.705e+01	4.954e+00	-3.442	0.000626 ***
as.factor(company)9	-1.231e+01	5.022e+00	-2.452	0.014572 *
as.factor(company)10	1.266e+00	5.348e+00	0.237	0.813002
as.factor(company)11	5.116e+00	4.743e+00	1.079	0.281225
as.factor(company)12	-9.118e+00	4.950e+00	-1.842	0.066066 .
as.factor(company)13	-1.144e+01	4.978e+00	-2.297	0.022031 *
as.factor(company)14	-1.131e+01	4.921e+00	-2.298	0.021998 *
as.factor(company)15	1.933e+01	5.830e+00	3.316	0.000981 ***
as.factor(company)16	-1.393e+01	3.591e+00	-3.880	0.000119 ***
as.factor(company)17	-9.878e+00	6.946e+00	-1.422	0.155662
as.factor(company)18	-1.258e+01	5.102e+00	-2.465	0.014024 *
as.factor(company)19	-1.280e+01	4.905e+00	-2.610	0.009329 **
as.factor(company)20	-1.374e+01	3.712e+00	-3.701	0.000239 ***
as.factor(company)21	-1.064e+01	4.873e+00	-2.183	0.029470 *
as.factor(company)22	-1.423e+01	6.952e+00	-2.047	0.041160 *
as.factor(company)23	-3.631e+00	5.342e+00	-0.680	0.496987
as.factor(company)24	-6.477e+00	5.077e+00	-1.276	0.202613
as.factor(company)26	-9.937e+00	5.076e+00	-1.958	0.050804 .
as.factor(company)27	-9.724e+00	5.413e+00	-1.797	0.073018 .
as.factor(company)28	-1.141e+01	5.333e+00	-2.139	0.032918 *
as.factor(company)29	4.318e+00	4.949e+00	0.873	0.383329
as.factor(company)30	-9.426e+00	5.027e+00	-1.875	0.061365 .

as.factor(company)32	-5.381e+00	5.005e+00	-1.075	0.282846	
as.factor(company)33	-1.473e+01	5.784e+00	-2.546	0.011186	*
as.factor(company)34	-1.135e+01	4.966e+00	-2.285	0.022759	*
as.factor(company)35	-1.625e+00	4.975e+00	-0.327	0.744137	
as.factor(company)36	-1.550e+01	6.983e+00	-2.219	0.026912	*
as.factor(company)37	-1.737e+01	5.040e+00	-3.447	0.000615	***
as.factor(company)38	-6.957e+00	5.008e+00	-1.389	0.165418	
as.factor(company)39	-1.054e+01	4.954e+00	-2.128	0.033794	*
as.factor(company)41	-1.511e+01	4.868e+00	-3.105	0.002013	**
as.factor(company)43	-1.529e+01	5.374e+00	-2.844	0.004634	**
as.factor(company)44	-1.323e+01	5.229e+00	-2.531	0.011682	*
as.factor(company)45	-8.056e+00	4.867e+00	-1.655	0.098525	.
as.factor(company)46	-1.251e+01	6.911e+00	-1.810	0.070955	.
as.factor(company)47	-1.186e+01	5.020e+00	-2.362	0.018560	*
as.factor(company)48	-2.358e+00	4.963e+00	-0.475	0.634934	
as.factor(company)49	-1.308e+01	4.989e+00	-2.622	0.009006	**
as.factor(company)50	-7.324e+00	5.183e+00	-1.413	0.158286	
as.factor(company)51	-6.555e+00	5.001e+00	-1.311	0.190519	
as.factor(company)52	-9.900e+00	4.037e+00	-2.452	0.014536	*
as.factor(company)53	-1.481e+01	4.442e+00	-3.333	0.000923	***
as.factor(company)54	-1.508e+01	5.765e+00	-2.615	0.009192	**
as.factor(company)55	7.144e+00	6.947e+00	1.028	0.304318	
as.factor(company)56	-6.163e+00	5.067e+00	-1.216	0.224419	
as.factor(company)57	-1.228e+01	6.970e+00	-1.762	0.078679	.
as.factor(company)59	-1.396e+01	5.739e+00	-2.433	0.015341	*
as.factor(company)60	-8.012e+00	5.037e+00	-1.591	0.112344	
as.factor(company)61	-1.114e+01	4.928e+00	-2.262	0.024159	*
as.factor(company)62	-1.331e+01	4.867e+00	-2.735	0.006468	**
as.factor(company)63	-1.253e+01	5.364e+00	-2.336	0.019901	*
as.factor(company)64	-5.506e+00	5.096e+00	-1.080	0.280499	
as.factor(company)65	-1.595e+01	5.225e+00	-3.053	0.002391	**
as.factor(company)66	-3.013e+00	5.143e+00	-0.586	0.558180	
as.factor(company)67	-1.120e+01	6.929e+00	-1.616	0.106813	
as.factor(company)68	-6.676e+00	4.973e+00	-1.342	0.180092	
as.factor(company)69	-1.150e+01	5.003e+00	-2.300	0.021883	*
as.factor(company)70	1.267e+01	3.590e+00	3.529	0.000457	***
as.factor(company)71	-5.573e+00	6.097e+00	-0.914	0.361089	
as.factor(company)72	-5.281e+00	4.082e+00	-1.294	0.196301	
as.factor(company)73	-7.312e+00	6.188e+00	-1.182	0.237927	
as.factor(company)74	-1.209e+01	4.884e+00	-2.476	0.013616	*
as.factor(company)75	-1.115e+01	3.802e+00	-2.932	0.003526	**
as.factor(company)76	9.007e+00	5.141e+00	1.752	0.080397	.
as.factor(company)77	-1.079e+01	4.567e+00	-2.362	0.018578	*
as.factor(company)79	5.387e+00	3.786e+00	1.423	0.155444	
as.factor(company)80	-7.973e+00	5.149e+00	-1.548	0.122152	
as.factor(company)81	-1.290e+01	4.960e+00	-2.600	0.009602	**
as.factor(company)82	-1.140e+01	4.853e+00	-2.350	0.019173	*
as.factor(company)83	-1.410e+01	5.006e+00	-2.816	0.005051	**
as.factor(company)84	-9.824e+00	5.015e+00	-1.959	0.050695	.
as.factor(company)85	4.810e+00	4.936e+00	0.974	0.330365	

```

as.factor(company)86 -1.240e+01 5.849e+00 -2.121 0.034440 *
as.factor(company)87 -1.164e+01 4.956e+00 -2.349 0.019241 *
as.factor(company)88 -1.221e+01 4.942e+00 -2.470 0.013847 *
as.factor(company)90 -2.465e+00 4.965e+00 -0.496 0.619785
as.factor(company)91 -1.379e+01 6.953e+00 -1.983 0.047906 *
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as.factor(company)98 -8.053e+00 4.965e+00 -1.622 0.105415
as.factor(company)99 -1.532e+01 3.593e+00 -4.264 2.41e-05 ***
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as.factor(company)103 -1.246e+01 5.119e+00 -2.433 0.015315 *
as.factor(company)104 -1.229e+01 5.686e+00 -2.162 0.031127 *
as.factor(company)105 -1.312e+01 4.928e+00 -2.663 0.008005 **
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as.factor(company)116 -1.563e+01 7.101e+00 -2.202 0.028140 *
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as.factor(company)118 -3.426e+01 6.860e+00 -4.995 8.17e-07 ***
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as.factor(company)136 -1.274e+01 5.328e+00 -2.391 0.017194 *
as.factor(company)137 2.372e+02 4.959e+00 47.818 < 2e-16 ***
as.factor(company)138 -1.044e+01 5.012e+00 -2.082 0.037817 *
as.factor(company)139 -4.997e+00 3.566e+00 -1.401 0.161768

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as.factor(company)145 -1.564e+01 6.966e+00 -2.245 0.025211 *
as.factor(company)146 -1.418e+01 3.492e+00 -4.061 5.68e-05 ***
as.factor(company)147 -1.071e+01 5.579e+00 -1.919 0.055568 .
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as.factor(company)158 -1.348e+01 4.967e+00 -2.714 0.006886 **
as.factor(company)159 -8.542e+00 5.012e+00 -1.704 0.088924 .
as.factor(company)160 -1.118e+01 5.891e+00 -1.899 0.058203 .
as.factor(company)161 -6.215e+00 5.127e+00 -1.212 0.225979
as.factor(company)162 -3.401e+00 4.870e+00 -0.698 0.485372
as.factor(company)163 -7.252e+00 1.099e+01 -0.660 0.509488
as.factor(company)164 -1.319e+01 4.825e+00 -2.734 0.006474 **
as.factor(company)165 -1.687e+01 3.515e+00 -4.800 2.10e-06 ***
as.factor(company)166 -7.525e+00 5.670e+00 -1.327 0.185062
as.factor(company)167 -1.862e+00 3.643e+00 -0.511 0.609390
as.factor(company)168 -1.157e+01 4.338e+00 -2.668 0.007887 **
as.factor(company)169 -1.339e+01 5.146e+00 -2.602 0.009534 **
as.factor(company)170 -8.360e+00 4.890e+00 -1.709 0.088008 .
as.factor(company)171 -7.617e+00 4.944e+00 -1.541 0.124010
as.factor(company)172 -8.689e+00 6.871e+00 -1.265 0.206597
as.factor(company)173 -1.756e+01 4.880e+00 -3.597 0.000354 ***
as.factor(company)174 -1.773e+01 6.836e+00 -2.594 0.009782 **
as.factor(company)175 -1.581e+01 5.956e+00 -2.655 0.008180 **
as.factor(company)176 -1.327e+01 4.815e+00 -2.756 0.006075 **
as.factor(company)177 -1.674e+01 5.983e+00 -2.798 0.005335 **
as.factor(company)178 -2.277e+01 4.898e+00 -4.649 4.28e-06 ***
as.factor(company)179 -9.736e+00 5.371e+00 -1.813 0.070489 .
as.factor(company)180 -4.479e+00 5.082e+00 -0.881 0.378531
as.factor(company)181 -1.091e+01 4.806e+00 -2.270 0.023654 *
as.factor(company)182 -1.736e+01 5.662e+00 -3.066 0.002292 **
as.factor(company)183 -6.550e+00 5.107e+00 -1.283 0.200222
as.factor(company)184 -1.682e+01 5.153e+00 -3.264 0.001177 **
as.factor(company)185 -8.236e+00 5.012e+00 -1.643 0.100931
as.factor(company)186 -9.871e+00 5.039e+00 -1.959 0.050667 .
as.factor(company)187 -1.385e+01 6.846e+00 -2.023 0.043662 *
as.factor(company)188 -1.081e+01 4.971e+00 -2.174 0.030180 *
as.factor(company)189 -1.416e+01 4.843e+00 -2.925 0.003609 **
as.factor(company)190 -1.054e+01 5.705e+00 -1.847 0.065299 .
as.factor(company)191 -1.125e+01 5.402e+00 -2.082 0.037832 *
as.factor(company)192 -1.476e+01 4.027e+00 -3.665 0.000275 ***
as.factor(company)193 -1.161e+01 6.843e+00 -1.697 0.090339 .
as.factor(company)194 -1.403e+01 4.855e+00 -2.890 0.004023 **
as.factor(company)195 -1.646e+01 3.997e+00 -4.117 4.50e-05 ***
as.factor(company)196 -6.596e+00 4.990e+00 -1.322 0.186825

```

```
as.factor(company)197 -1.446e+01 7.005e+00 -2.064 0.039586 *
as.factor(company)199 -1.055e+01 4.994e+00 -2.113 0.035118 *
as.numeric(nib) -7.539e-01 4.430e-01 -1.702 0.089457 .
as.numeric(nbmeeting) -2.906e-02 1.386e-01 -0.210 0.833965
```

---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 5.411 on 493 degrees of freedom  
(64 observations deleted due to missingness)  
Multiple R-squared: 0.9583, Adjusted R-squared: 0.9425  
F-statistic: 60.55 on 187 and 493 DF, p-value: < 2.2e-16

### Appendix 3: ROA output with time effect

The following output shows the results for ROA with taking time into consideration.

```
summary(olswt)
```

Call:

```
lm(formula = ROA ~ +as.numeric(Audit) + (as.numeric(board_size)) +  
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
  as.numeric(employees) + as.factor(company) + as.factor(Year) +  
  as.numeric(nib) + as.numeric(nbmeeting), data = mydata)
```

Residuals:

```
  Min    1Q  Median    3Q   Max  
-26.037 -1.446  0.016  1.491 40.454
```

Coefficients:

```
              Estimate Std. Error t value Pr(>|t|)  
(Intercept)    2.482e+01 1.139e+01  2.180 0.029765 *  
as.numeric(Audit) -2.239e+00 8.377e+00 -0.267 0.789384  
as.numeric(board_size) 3.577e-01 3.960e-01  0.903 0.366815  
as.factor(industry)1 -1.162e+00 3.353e+00 -0.346 0.729142  
as.numeric(leverage) 2.637e-04 1.663e-03  0.159 0.874051  
as.numeric(nbcom) -9.320e-01 7.793e-01 -1.196 0.232280  
as.numeric(employees) -1.521e-03 2.147e-03 -0.709 0.478887  
as.factor(company)2  1.397e+00 6.026e+00  0.232 0.816783  
as.factor(company)3 -6.404e+00 3.539e+00 -1.810 0.070961 .  
as.factor(company)4 -7.697e+00 5.035e+00 -1.529 0.126988  
as.factor(company)5 -5.880e+00 3.739e+00 -1.573 0.116418  
as.factor(company)6 -1.103e+01 5.207e+00 -2.118 0.034666 *  
as.factor(company)8 -1.677e+01 4.959e+00 -3.382 0.000778 ***  
as.factor(company)9 -1.229e+01 5.019e+00 -2.449 0.014694 *  
as.factor(company)10 1.114e+00 5.344e+00  0.209 0.834888  
as.factor(company)11 4.800e+00 4.747e+00  1.011 0.312382  
as.factor(company)12 -9.141e+00 4.951e+00 -1.846 0.065438 .  
as.factor(company)13 -1.159e+01 4.977e+00 -2.328 0.020324 *  
as.factor(company)14 -1.107e+01 4.921e+00 -2.250 0.024916 *  
as.factor(company)15 1.961e+01 5.841e+00  3.358 0.000847 ***  
as.factor(company)16 -1.374e+01 3.591e+00 -3.827 0.000147 ***  
as.factor(company)17 -1.025e+01 6.963e+00 -1.472 0.141564  
as.factor(company)18 -1.230e+01 5.117e+00 -2.404 0.016593 *  
as.factor(company)19 -1.252e+01 4.905e+00 -2.552 0.011021 *  
as.factor(company)20 -1.360e+01 3.711e+00 -3.665 0.000274 ***  
as.factor(company)21 -1.052e+01 4.871e+00 -2.160 0.031275 *  
as.factor(company)22 -1.446e+01 6.965e+00 -2.076 0.038445 *  
as.factor(company)23 -3.641e+00 5.338e+00 -0.682 0.495595
```

as.factor(company)24	-6.538e+00	5.082e+00	-1.287	0.198869
as.factor(company)26	-9.744e+00	5.084e+00	-1.917	0.055845 .
as.factor(company)27	-9.290e+00	5.421e+00	-1.714	0.087237 .
as.factor(company)28	-1.100e+01	5.337e+00	-2.061	0.039789 *
as.factor(company)29	4.558e+00	4.951e+00	0.921	0.357708
as.factor(company)30	-9.162e+00	5.030e+00	-1.821	0.069147 .
as.factor(company)32	-5.323e+00	5.007e+00	-1.063	0.288208
as.factor(company)33	-1.494e+01	5.781e+00	-2.583	0.010070 *
as.factor(company)34	-1.143e+01	4.964e+00	-2.303	0.021710 *
as.factor(company)35	-1.555e+00	4.976e+00	-0.312	0.754822
as.factor(company)36	-1.525e+01	6.988e+00	-2.182	0.029582 *
as.factor(company)37	-1.714e+01	5.051e+00	-3.393	0.000748 ***
as.factor(company)38	-6.816e+00	5.006e+00	-1.362	0.173981
as.factor(company)39	-1.031e+01	4.959e+00	-2.079	0.038165 *
as.factor(company)41	-1.499e+01	4.868e+00	-3.079	0.002191 **
as.factor(company)43	-1.552e+01	5.375e+00	-2.887	0.004067 **
as.factor(company)44	-1.309e+01	5.243e+00	-2.496	0.012902 *
as.factor(company)45	-7.927e+00	4.868e+00	-1.628	0.104079
as.factor(company)46	-1.276e+01	6.931e+00	-1.841	0.066166 .
as.factor(company)47	-1.151e+01	5.023e+00	-2.292	0.022341 *
as.factor(company)48	-2.258e+00	4.962e+00	-0.455	0.649298
as.factor(company)49	-1.284e+01	4.989e+00	-2.573	0.010369 *
as.factor(company)50	-7.308e+00	5.194e+00	-1.407	0.160023
as.factor(company)51	-6.520e+00	5.003e+00	-1.303	0.193050
as.factor(company)52	-9.796e+00	4.040e+00	-2.425	0.015690 *
as.factor(company)53	-1.440e+01	4.478e+00	-3.216	0.001388 **
as.factor(company)54	-1.539e+01	5.769e+00	-2.668	0.007875 **
as.factor(company)55	7.443e+00	6.953e+00	1.070	0.284952
as.factor(company)56	-5.964e+00	5.069e+00	-1.177	0.239916
as.factor(company)57	-1.202e+01	6.968e+00	-1.725	0.085216 .
as.factor(company)59	-1.383e+01	5.744e+00	-2.407	0.016438 *
as.factor(company)60	-8.094e+00	5.040e+00	-1.606	0.108926
as.factor(company)61	-1.109e+01	4.933e+00	-2.247	0.025088 *
as.factor(company)62	-1.315e+01	4.868e+00	-2.701	0.007155 **
as.factor(company)63	-1.228e+01	5.373e+00	-2.285	0.022723 *
as.factor(company)64	-5.238e+00	5.105e+00	-1.026	0.305409
as.factor(company)65	-1.594e+01	5.221e+00	-3.052	0.002393 **
as.factor(company)66	-2.667e+00	5.142e+00	-0.519	0.604282
as.factor(company)67	-1.056e+01	6.938e+00	-1.523	0.128529
as.factor(company)68	-6.555e+00	4.974e+00	-1.318	0.188135
as.factor(company)69	-1.127e+01	5.007e+00	-2.251	0.024842 *
as.factor(company)70	1.268e+01	3.587e+00	3.534	0.000447 ***
as.factor(company)71	-5.959e+00	6.097e+00	-0.977	0.328832
as.factor(company)72	-5.430e+00	4.088e+00	-1.328	0.184768
as.factor(company)73	-7.883e+00	6.192e+00	-1.273	0.203598
as.factor(company)74	-1.185e+01	4.883e+00	-2.426	0.015625 *
as.factor(company)75	-1.127e+01	3.809e+00	-2.960	0.003226 **
as.factor(company)76	9.048e+00	5.138e+00	1.761	0.078886 .
as.factor(company)77	-1.051e+01	4.581e+00	-2.293	0.022248 *
as.factor(company)79	5.255e+00	3.784e+00	1.389	0.165496

as.factor(company)80	-7.868e+00	5.148e+00	-1.528	0.127107	
as.factor(company)81	-1.287e+01	4.961e+00	-2.595	0.009730	**
as.factor(company)82	-1.154e+01	4.861e+00	-2.374	0.017959	*
as.factor(company)83	-1.388e+01	5.004e+00	-2.773	0.005762	**
as.factor(company)84	-9.942e+00	5.020e+00	-1.980	0.048212	*
as.factor(company)85	5.011e+00	4.937e+00	1.015	0.310549	
as.factor(company)86	-1.236e+01	5.857e+00	-2.110	0.035363	*
as.factor(company)87	-1.155e+01	4.955e+00	-2.331	0.020165	*
as.factor(company)88	-1.219e+01	4.946e+00	-2.465	0.014037	*
as.factor(company)90	-2.326e+00	4.962e+00	-0.469	0.639531	
as.factor(company)91	-1.399e+01	6.966e+00	-2.008	0.045196	*
as.factor(company)92	-1.264e+01	4.909e+00	-2.575	0.010325	*
as.factor(company)93	-2.810e+00	5.795e+00	-0.485	0.627961	
as.factor(company)94	-9.264e+00	4.983e+00	-1.859	0.063630	.
as.factor(company)95	-1.881e+01	5.393e+00	-3.488	0.000530	***
as.factor(company)96	-1.185e+01	5.004e+00	-2.368	0.018288	*
as.factor(company)97	-8.103e+00	6.998e+00	-1.158	0.247486	
as.factor(company)98	-7.973e+00	4.963e+00	-1.606	0.108824	
as.factor(company)99	-1.495e+01	3.597e+00	-4.155	3.84e-05	***
as.factor(company)100	-1.492e+01	4.643e+00	-3.213	0.001401	**
as.factor(company)101	-1.559e+01	3.818e+00	-4.084	5.16e-05	***
as.factor(company)102	-1.491e+01	4.276e+00	-3.486	0.000534	***
as.factor(company)103	-1.203e+01	5.130e+00	-2.346	0.019371	*
as.factor(company)104	-1.202e+01	5.694e+00	-2.111	0.035265	*
as.factor(company)105	-1.321e+01	4.927e+00	-2.682	0.007569	**
as.factor(company)106	3.945e+00	5.353e+00	0.737	0.461515	
as.factor(company)107	-1.108e+01	5.028e+00	-2.204	0.028021	*
as.factor(company)109	-1.311e+01	5.340e+00	-2.455	0.014416	*
as.factor(company)110	-1.192e+01	6.971e+00	-1.711	0.087792	.
as.factor(company)111	-8.791e+00	4.852e+00	-1.812	0.070657	.
as.factor(company)112	-1.562e+01	5.707e+00	-2.737	0.006429	**
as.factor(company)113	-8.995e+00	4.955e+00	-1.815	0.070061	.
as.factor(company)114	9.969e+00	4.979e+00	2.002	0.045809	*
as.factor(company)115	-1.017e+01	6.947e+00	-1.464	0.143952	
as.factor(company)116	-1.578e+01	7.128e+00	-2.214	0.027294	*
as.factor(company)117	-1.504e+01	4.077e+00	-3.690	0.000250	***
as.factor(company)118	-3.422e+01	6.869e+00	-4.982	8.76e-07	***
as.factor(company)119	-1.379e+01	5.816e+00	-2.371	0.018117	*
as.factor(company)120	-1.701e+01	4.875e+00	-3.489	0.000529	***
as.factor(company)121	-1.434e+01	4.840e+00	-2.962	0.003203	**
as.factor(company)122	-4.451e+00	4.856e+00	-0.916	0.359870	
as.factor(company)123	-1.652e+01	4.879e+00	-3.386	0.000766	***
as.factor(company)124	-1.591e+01	6.052e+00	-2.629	0.008835	**
as.factor(company)125	-9.643e+00	1.096e+01	-0.880	0.379486	
as.factor(company)126	-1.342e+01	5.050e+00	-2.658	0.008115	**
as.factor(company)127	-1.254e+01	7.056e+00	-1.778	0.076023	.
as.factor(company)128	-7.398e+00	3.469e+00	-2.133	0.033444	*
as.factor(company)129	-1.387e+01	4.076e+00	-3.403	0.000721	***
as.factor(company)130	-1.334e+01	1.091e+01	-1.223	0.221855	
as.factor(company)131	-1.289e+00	5.032e+00	-0.256	0.797987	

as.factor(company)132 -5.393e+00 4.855e+00 -1.111 0.267148  
as.factor(company)134 -5.147e+00 5.099e+00 -1.009 0.313245  
as.factor(company)136 -1.280e+01 5.325e+00 -2.404 0.016602 \*  
as.factor(company)137 2.372e+02 4.957e+00 47.841 < 2e-16 \*\*\*  
as.factor(company)138 -1.014e+01 5.013e+00 -2.022 0.043697 \*  
as.factor(company)139 -4.901e+00 3.575e+00 -1.371 0.171074  
as.factor(company)140 -1.378e+01 5.071e+00 -2.718 0.006798 \*\*  
as.factor(company)141 1.780e+00 5.791e+00 0.307 0.758765  
as.factor(company)143 -1.253e+01 4.977e+00 -2.518 0.012107 \*  
as.factor(company)144 -7.860e+00 4.982e+00 -1.578 0.115249  
as.factor(company)145 -1.607e+01 6.983e+00 -2.301 0.021822 \*  
as.factor(company)146 -1.418e+01 3.490e+00 -4.063 5.65e-05 \*\*\*  
as.factor(company)147 -1.022e+01 5.596e+00 -1.826 0.068453 .  
as.factor(company)153 -1.118e+01 4.880e+00 -2.290 0.022441 \*  
as.factor(company)154 -1.012e+01 6.984e+00 -1.449 0.148035  
as.factor(company)155 -2.985e+00 4.869e+00 -0.613 0.540167  
as.factor(company)157 -6.703e+00 4.876e+00 -1.375 0.169825  
as.factor(company)158 -1.354e+01 4.965e+00 -2.728 0.006598 \*\*  
as.factor(company)159 -8.448e+00 5.010e+00 -1.686 0.092369 .  
as.factor(company)160 -1.086e+01 5.908e+00 -1.839 0.066522 .  
as.factor(company)161 -6.217e+00 5.122e+00 -1.214 0.225433  
as.factor(company)162 -3.310e+00 4.871e+00 -0.679 0.497176  
as.factor(company)163 -8.647e+00 1.100e+01 -0.786 0.432289  
as.factor(company)164 -1.330e+01 4.828e+00 -2.755 0.006092 \*\*  
as.factor(company)165 -1.688e+01 3.516e+00 -4.801 2.10e-06 \*\*\*  
as.factor(company)166 -7.689e+00 5.680e+00 -1.354 0.176429  
as.factor(company)167 -1.999e+00 3.640e+00 -0.549 0.583208  
as.factor(company)168 -1.109e+01 4.339e+00 -2.556 0.010901 \*  
as.factor(company)169 -1.329e+01 5.145e+00 -2.583 0.010097 \*  
as.factor(company)170 -8.216e+00 4.893e+00 -1.679 0.093726 .  
as.factor(company)171 -7.557e+00 4.942e+00 -1.529 0.126875  
as.factor(company)172 -8.294e+00 6.888e+00 -1.204 0.229138  
as.factor(company)173 -1.742e+01 4.881e+00 -3.569 0.000394 \*\*\*  
as.factor(company)174 -1.841e+01 6.850e+00 -2.688 0.007437 \*\*  
as.factor(company)175 -1.611e+01 5.966e+00 -2.701 0.007153 \*\*  
as.factor(company)176 -1.332e+01 4.813e+00 -2.768 0.005851 \*\*  
as.factor(company)177 -1.661e+01 5.985e+00 -2.776 0.005718 \*\*  
as.factor(company)178 -2.285e+01 4.899e+00 -4.664 4.01e-06 \*\*\*  
as.factor(company)179 -9.514e+00 5.371e+00 -1.771 0.077128 .  
as.factor(company)180 -4.382e+00 5.090e+00 -0.861 0.389680  
as.factor(company)181 -1.086e+01 4.805e+00 -2.260 0.024290 \*  
as.factor(company)182 -1.762e+01 5.675e+00 -3.106 0.002008 \*\*  
as.factor(company)183 -6.383e+00 5.109e+00 -1.249 0.212093  
as.factor(company)184 -1.687e+01 5.151e+00 -3.274 0.001134 \*\*  
as.factor(company)185 -8.019e+00 5.016e+00 -1.599 0.110544  
as.factor(company)186 -9.861e+00 5.042e+00 -1.956 0.051050 .  
as.factor(company)187 -1.443e+01 6.856e+00 -2.105 0.035838 \*  
as.factor(company)188 -1.072e+01 4.971e+00 -2.156 0.031554 \*  
as.factor(company)189 -1.414e+01 4.842e+00 -2.920 0.003664 \*\*  
as.factor(company)190 -1.035e+01 5.721e+00 -1.808 0.071168 .

```

as.factor(company)191 -1.110e+01 5.411e+00 -2.052 0.040661 *
as.factor(company)192 -1.433e+01 4.041e+00 -3.545 0.000430 ***
as.factor(company)193 -1.080e+01 6.855e+00 -1.575 0.115935
as.factor(company)194 -1.406e+01 4.855e+00 -2.896 0.003943 **
as.factor(company)195 -1.639e+01 4.006e+00 -4.090 5.03e-05 ***
as.factor(company)196 -6.514e+00 4.991e+00 -1.305 0.192467
as.factor(company)197 -1.400e+01 7.012e+00 -1.997 0.046354 *
as.factor(company)199 -1.063e+01 4.992e+00 -2.130 0.033639 *
as.factor(Year)2014 8.541e-01 7.088e-01 1.205 0.228739
as.factor(Year)2015 1.160e-01 7.318e-01 0.159 0.874109
as.factor(Year)2016 -5.498e-01 7.545e-01 -0.729 0.466545
as.factor(Year)2017 6.033e-01 7.357e-01 0.820 0.412612
as.numeric(nib) -7.405e-01 4.603e-01 -1.609 0.108305
as.numeric(nbmeeting) -4.768e-02 1.493e-01 -0.319 0.749554

```

---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 5.404 on 489 degrees of freedom  
(64 observations deleted due to missingness)  
Multiple R-squared: 0.9587, Adjusted R-squared: 0.9426  
F-statistic: 59.45 on 191 and 489 DF, p-value: < 2.2e-16

## Appendix 4: ROA OLS output

The following output (using ordinary least square method) ignored both time and companies' effect with ROA.

```
ols2 <-  
lm(ROA~+as.numeric(Audit)+(as.numeric(board_size))+as.factor(industry)+as.numeric(leverage)+as.numeric(nbcom)+as.numeric(employees)+as.numeric(nib)+as.numeric(nbmeeting), data=mydata)  
  
summary(ols2)
```

Call:

```
lm(formula = ROA ~ +as.numeric(Audit) + (as.numeric(board_size)) +  
    as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
    as.numeric(employees) + as.numeric(nib) + as.numeric(nbmeeting),  
    data = mydata)
```

Residuals:

Min	1Q	Median	3Q	Max
-31.210	-6.698	-1.598	2.762	249.072

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	32.100123	8.191576	3.919	9.82e-05 ***
as.numeric(Audit)	4.818390	6.740731	0.715	0.47497
as.numeric(board_size)	-0.975516	0.698982	-1.396	0.16329
as.factor(industry)1	-1.539586	2.409255	-0.639	0.52302
as.numeric(leverage)	-0.020816	0.004174	-4.987	7.83e-07 ***
as.numeric(nbcom)	-3.584221	1.168632	-3.067	0.00225 **
as.numeric(employees)	0.005759	0.004067	1.416	0.15719
as.numeric(nib)	0.301754	0.804261	0.375	0.70763
as.numeric(nbmeeting)	-0.080419	0.350926	-0.229	0.81881

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 21.89 on 672 degrees of freedom

(64 observations deleted due to missingness)

Multiple R-squared: 0.06918, Adjusted R-squared: 0.05809

F-statistic: 6.243 on 8 and 672 DF, p-value: 8.337e-08



## Appendix 5: ROA fixed model

This is the fixed model that takes companies' effect as factors.

Oneway (individual) effect Between Model

Call:

```
plm(formula = ROA ~ as.numeric(Audit) + (as.numeric(board_size)) +  
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
  as.numeric(employees) + as.numeric(nib) + as.numeric(nbmeeting),  
  data = mydata, model = "between", index = c("company"))
```

Unbalanced Panel: n = 180, T = 1-5, N = 681

Observations used in estimation: 180

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-30.32926	-5.40913	-0.75183	3.17023	234.92089

Coefficients:

	Estimate	Std. Error	t-value	Pr(> t )
(Intercept)	34.7302771	14.0002955	2.4807	0.014080 *
as.numeric(Audit)	3.0091357	10.9208493	0.2755	0.783234
as.numeric(board_size)	-1.1867578	1.2963523	-0.9155	0.361240
as.factor(industry)1	-1.8909339	4.0937127	-0.4619	0.644732
as.numeric(leverage)	-0.0261351	0.0083903	-3.1149	0.002158 **
as.numeric(nbcom)	-3.4809019	2.2503888	-1.5468	0.123760
as.numeric(employees)	0.0082303	0.0075488	1.0903	0.277126
as.numeric(nib)	0.7199976	1.5532249	0.4636	0.643560
as.numeric(nbmeeting)	-0.2955304	0.7341947	-0.4025	0.687802

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 68979

Residual Sum of Squares: 62810

R-Squared: 0.089422

Adj. R-Squared: 0.046822

F-statistic: 2.09911 on 8 and 171 DF, p-value: 0.038333

## Appendix 6: ROA f-test

This is F test to show which model is better (fixed model or ordinary least square method).

```
pFtest(fixed,ols2)
```

F test for individual effects

```
data: ROA ~ as.numeric(Audit) + (as.numeric(board_size)) + as.factor(industry) + ...
```

```
F = 1.4085, df1 = 501, df2 = 171, p-value = 0.004235
```

```
alternative hypothesis: significant effects
```

## Appendix 7: Tobin's Q output without time effect

The following output shows the results for Tobin's Q ignoring time effect.

```
olswt <-  
lm(TobinQ~+as.numeric(Audit)+(as.numeric(board_size))+as.factor(industry)+as.nu  
meric(leverage)+as.numeric(nbcom)+as.numeric(employees)+as.factor(company)+as.  
numeric(nib)+as.numeric(nbmeeting), data=mydata)  
  
summary(olswt)
```

Call:

```
lm(formula = TobinQ ~ +as.numeric(Audit) + (as.numeric(board_size)) +  
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
  as.numeric(employees) + as.factor(company) + as.numeric(nib) +  
  as.numeric(nbmeeting), data = mydata)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.0070847	-0.0000885	0.0000000	0.0000992	0.0093031

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	1.133e-03	1.380e-03	0.821	0.411840
as.numeric(Audit)	-9.780e-05	1.030e-03	-0.095	0.924423
as.numeric(board_size)	4.462e-05	4.605e-05	0.969	0.333119
as.factor(industry)1	3.614e-05	4.096e-04	0.088	0.929719
as.numeric(leverage)	-1.906e-07	2.030e-07	-0.939	0.348179
as.numeric(nbcom)	-6.453e-05	8.954e-05	-0.721	0.471447
as.numeric(employees)	1.937e-07	2.493e-07	0.777	0.437513
as.factor(company)2	8.876e-05	7.423e-04	0.120	0.904868
as.factor(company)3	3.132e-04	4.361e-04	0.718	0.472925
as.factor(company)4	9.316e-04	6.185e-04	1.506	0.132591
as.factor(company)5	-1.301e-04	4.597e-04	-0.283	0.777237
as.factor(company)6	-1.698e-05	6.401e-04	-0.027	0.978842
as.factor(company)7	-6.207e-04	5.700e-04	-1.089	0.276742
as.factor(company)8	-4.341e-04	6.080e-04	-0.714	0.475529
as.factor(company)9	-2.789e-06	5.985e-04	-0.005	0.996283
as.factor(company)10	6.563e-03	6.555e-04	10.013	< 2e-16 ***
as.factor(company)11	2.284e-03	5.828e-04	3.919	0.000101 ***
as.factor(company)12	2.523e-04	6.073e-04	0.415	0.678006
as.factor(company)13	1.051e-03	6.091e-04	1.725	0.085168 .
as.factor(company)14	3.398e-04	6.035e-04	0.563	0.573679
as.factor(company)15	8.905e-03	7.156e-04	12.444	< 2e-16 ***
as.factor(company)16	-7.267e-04	4.417e-04	-1.645	0.100535
as.factor(company)17	7.699e-04	8.542e-04	0.901	0.367795
as.factor(company)18	1.092e-04	6.237e-04	0.175	0.861097

as.factor(company)19	-1.880e-04	6.011e-04	-0.313	0.754618
as.factor(company)20	-7.157e-04	4.555e-04	-1.571	0.116708
as.factor(company)21	-2.008e-04	5.977e-04	-0.336	0.736998
as.factor(company)22	1.376e-04	8.552e-04	0.161	0.872227
as.factor(company)23	1.302e-04	6.547e-04	0.199	0.842410
as.factor(company)24	4.581e-05	6.223e-04	0.074	0.941348
as.factor(company)25	-3.095e-04	8.740e-04	-0.354	0.723414
as.factor(company)26	-2.868e-04	6.219e-04	-0.461	0.644901
as.factor(company)27	1.179e-03	6.145e-04	1.918	0.055606
as.factor(company)28	-2.635e-04	6.473e-04	-0.407	0.684116
as.factor(company)29	9.886e-04	6.073e-04	1.628	0.104165
as.factor(company)30	-4.343e-04	6.159e-04	-0.705	0.480995
as.factor(company)32	3.404e-04	6.110e-04	0.557	0.577654
as.factor(company)33	1.286e-03	7.101e-04	1.812	0.070624
as.factor(company)34	4.997e-04	6.078e-04	0.822	0.411358
as.factor(company)35	2.581e-03	6.099e-04	4.232	2.74e-05 ***
as.factor(company)36	-5.363e-04	8.588e-04	-0.624	0.532596
as.factor(company)37	-3.575e-05	6.175e-04	-0.058	0.953852
as.factor(company)38	-1.792e-04	5.985e-04	-0.299	0.764738
as.factor(company)39	-6.494e-04	6.082e-04	-1.068	0.286179
as.factor(company)40	-7.551e-04	7.364e-04	-1.025	0.305660
as.factor(company)41	-2.760e-04	5.971e-04	-0.462	0.644079
as.factor(company)42	-7.275e-04	7.381e-04	-0.986	0.324722
as.factor(company)43	1.631e-04	6.579e-04	0.248	0.804307
as.factor(company)44	2.575e-05	6.413e-04	0.040	0.967987
as.factor(company)45	9.329e-04	5.976e-04	1.561	0.119112
as.factor(company)46	5.595e-04	8.508e-04	0.658	0.511093
as.factor(company)47	-2.886e-04	6.140e-04	-0.470	0.638511
as.factor(company)48	2.155e-03	6.080e-04	3.544	0.000430 ***
as.factor(company)49	-3.053e-04	6.110e-04	-0.500	0.617508
as.factor(company)50	-3.541e-04	6.358e-04	-0.557	0.577805
as.factor(company)51	1.014e-03	6.127e-04	1.655	0.098589
as.factor(company)52	-2.594e-04	4.641e-04	-0.559	0.576552
as.factor(company)53	-4.205e-04	5.447e-04	-0.772	0.440433
as.factor(company)54	8.579e-05	7.075e-04	0.121	0.903533
as.factor(company)55	3.888e-03	8.546e-04	4.550	6.68e-06 ***
as.factor(company)56	2.922e-04	6.206e-04	0.471	0.637911
as.factor(company)57	8.364e-04	8.575e-04	0.975	0.329807
as.factor(company)59	-5.064e-04	7.046e-04	-0.719	0.472661
as.factor(company)60	1.312e-03	6.169e-04	2.126	0.033949 *
as.factor(company)61	-8.372e-04	6.051e-04	-1.384	0.167096
as.factor(company)62	-6.587e-05	5.969e-04	-0.110	0.912180
as.factor(company)63	-2.311e-04	6.114e-04	-0.378	0.705626
as.factor(company)64	7.315e-04	6.245e-04	1.171	0.242019
as.factor(company)65	-4.249e-04	6.418e-04	-0.662	0.508260
as.factor(company)66	-2.704e-04	6.304e-04	-0.429	0.668138
as.factor(company)67	-4.523e-04	8.519e-04	-0.531	0.595711
as.factor(company)68	1.681e-03	6.098e-04	2.757	0.006036 **
as.factor(company)69	-4.828e-04	6.128e-04	-0.788	0.431127
as.factor(company)70	7.740e-03	4.419e-04	17.515	< 2e-16 ***

as.factor(company)71	1.272e-03	7.512e-04	1.693	0.091052	.
as.factor(company)73	2.109e-04	7.610e-04	0.277	0.781777	
as.factor(company)74	1.008e-03	5.994e-04	1.682	0.093164	.
as.factor(company)75	-3.638e-04	4.684e-04	-0.777	0.437674	
as.factor(company)76	2.965e-03	6.305e-04	4.704	3.28e-06	***
as.factor(company)77	-6.153e-04	5.370e-04	-1.146	0.252462	
as.factor(company)78	-7.177e-04	4.579e-04	-1.567	0.117636	
as.factor(company)79	2.534e-03	4.655e-04	5.443	8.11e-08	***
as.factor(company)80	1.410e-03	6.118e-04	2.305	0.021558	*
as.factor(company)81	1.163e-05	6.081e-04	0.019	0.984753	
as.factor(company)82	-1.824e-05	5.960e-04	-0.031	0.975598	
as.factor(company)83	1.804e-04	6.134e-04	0.294	0.768876	
as.factor(company)84	3.444e-04	6.142e-04	0.561	0.575282	
as.factor(company)85	2.376e-03	6.053e-04	3.925	9.83e-05	***
as.factor(company)86	-6.222e-04	7.174e-04	-0.867	0.386245	
as.factor(company)87	1.610e-03	6.075e-04	2.650	0.008301	**
as.factor(company)88	-4.719e-04	6.066e-04	-0.778	0.436972	
as.factor(company)89	5.445e-04	8.460e-04	0.644	0.520089	
as.factor(company)90	1.760e-03	6.078e-04	2.895	0.003945	**
as.factor(company)91	-1.130e-04	8.554e-04	-0.132	0.894974	
as.factor(company)92	-2.501e-04	6.036e-04	-0.414	0.678762	
as.factor(company)93	1.919e-03	7.103e-04	2.702	0.007115	**
as.factor(company)94	5.046e-04	6.107e-04	0.826	0.409038	
as.factor(company)95	1.890e-03	6.603e-04	2.862	0.004373	**
as.factor(company)96	-1.904e-04	6.127e-04	-0.311	0.756127	
as.factor(company)97	7.836e-04	8.575e-04	0.914	0.361242	
as.factor(company)98	-3.162e-04	6.083e-04	-0.520	0.603409	
as.factor(company)99	-9.118e-04	4.416e-04	-2.064	0.039467	*
as.factor(company)100	-8.677e-04	4.458e-04	-1.947	0.052128	.
as.factor(company)101	-8.862e-04	4.452e-04	-1.991	0.047053	*
as.factor(company)102	4.064e-04	5.233e-04	0.777	0.437776	
as.factor(company)103	-1.758e-04	6.266e-04	-0.281	0.779113	
as.factor(company)104	-6.239e-04	6.989e-04	-0.893	0.372425	
as.factor(company)105	-3.015e-05	6.039e-04	-0.050	0.960193	
as.factor(company)106	1.017e-05	6.568e-04	0.015	0.987658	
as.factor(company)107	5.486e-04	6.171e-04	0.889	0.374397	
as.factor(company)108	-6.715e-04	7.378e-04	-0.910	0.363186	
as.factor(company)109	1.408e-04	6.539e-04	0.215	0.829592	
as.factor(company)110	-4.352e-04	8.549e-04	-0.509	0.610898	
as.factor(company)111	-3.742e-05	5.960e-04	-0.063	0.949969	
as.factor(company)112	-2.337e-04	7.000e-04	-0.334	0.738637	
as.factor(company)113	-2.958e-04	6.060e-04	-0.488	0.625655	
as.factor(company)114	2.999e-03	6.094e-04	4.922	1.15e-06	***
as.factor(company)115	-6.610e-04	8.522e-04	-0.776	0.438289	
as.factor(company)116	5.588e-03	8.711e-04	6.414	3.18e-10	***
as.factor(company)117	-8.903e-04	4.437e-04	-2.006	0.045338	*
as.factor(company)118	8.159e-04	8.442e-04	0.966	0.334281	
as.factor(company)119	4.648e-04	7.106e-04	0.654	0.513374	
as.factor(company)120	-5.997e-05	5.984e-04	-0.100	0.920219	
as.factor(company)121	-3.636e-04	5.942e-04	-0.612	0.540898	

as.factor(company)122	2.883e-04	5.967e-04	0.483	0.629175
as.factor(company)123	-2.131e-04	5.988e-04	-0.356	0.722027
as.factor(company)124	-7.301e-04	7.450e-04	-0.980	0.327547
as.factor(company)125	6.173e-05	1.348e-03	0.046	0.963482
as.factor(company)126	-9.923e-04	6.194e-04	-1.602	0.109727
as.factor(company)127	-4.064e-04	8.669e-04	-0.469	0.639361
as.factor(company)128	4.594e-04	4.277e-04	1.074	0.283299
as.factor(company)129	-7.008e-04	4.941e-04	-1.418	0.156679
as.factor(company)130	9.116e-04	1.330e-03	0.685	0.493370
as.factor(company)131	1.334e-03	6.166e-04	2.164	0.030895 *
as.factor(company)132	2.148e-04	5.959e-04	0.360	0.718688
as.factor(company)134	3.344e-04	6.247e-04	0.535	0.592593
as.factor(company)135	-9.200e-04	5.902e-04	-1.559	0.119667
as.factor(company)136	-1.222e-04	6.534e-04	-0.187	0.851719
as.factor(company)137	6.111e-02	6.077e-04	100.564	< 2e-16 ***
as.factor(company)138	-1.351e-04	6.140e-04	-0.220	0.825993
as.factor(company)139	-9.230e-05	4.389e-04	-0.210	0.833523
as.factor(company)140	-1.348e-04	6.186e-04	-0.218	0.827617
as.factor(company)141	3.612e-03	7.108e-04	5.082	5.23e-07 ***
as.factor(company)142	-7.588e-04	4.483e-04	-1.693	0.091136 .
as.factor(company)143	-6.810e-04	6.100e-04	-1.116	0.264752
as.factor(company)144	-1.553e-04	6.115e-04	-0.254	0.799625
as.factor(company)145	-8.732e-05	8.563e-04	-0.102	0.918823
as.factor(company)146	-5.322e-04	4.305e-04	-1.236	0.216977
as.factor(company)147	1.838e-03	6.832e-04	2.690	0.007381 **
as.factor(company)153	-3.508e-04	5.989e-04	-0.586	0.558283
as.factor(company)154	-2.835e-04	7.137e-04	-0.397	0.691375
as.factor(company)155	1.034e-03	5.978e-04	1.730	0.084201 .
as.factor(company)156	1.619e-03	6.582e-04	2.460	0.014214 *
as.factor(company)157	1.074e-03	5.981e-04	1.796	0.073030 .
as.factor(company)158	4.630e-05	6.079e-04	0.076	0.939319
as.factor(company)159	4.300e-04	6.128e-04	0.702	0.483169
as.factor(company)160	-4.925e-04	7.233e-04	-0.681	0.496265
as.factor(company)161	8.853e-04	6.283e-04	1.409	0.159391
as.factor(company)162	1.971e-03	5.981e-04	3.296	0.001049 **
as.factor(company)163	1.339e-03	1.351e-03	0.992	0.321891
as.factor(company)164	-1.786e-04	5.927e-04	-0.301	0.763342
as.factor(company)165	-8.980e-04	4.337e-04	-2.071	0.038877 *
as.factor(company)166	1.816e-04	6.975e-04	0.260	0.794722
as.factor(company)167	1.090e-05	4.482e-04	0.024	0.980612
as.factor(company)168	-7.488e-04	5.244e-04	-1.428	0.153896
as.factor(company)169	1.113e-03	6.307e-04	1.766	0.078052 .
as.factor(company)170	3.949e-04	6.007e-04	0.657	0.511188
as.factor(company)171	6.654e-05	6.058e-04	0.110	0.912583
as.factor(company)172	1.084e-03	8.461e-04	1.281	0.200729
as.factor(company)173	-3.895e-04	5.991e-04	-0.650	0.515879
as.factor(company)174	-3.317e-04	8.418e-04	-0.394	0.693701
as.factor(company)175	-8.437e-04	7.351e-04	-1.148	0.251592
as.factor(company)176	-2.011e-06	5.911e-04	-0.003	0.997287
as.factor(company)178	-1.708e-04	6.010e-04	-0.284	0.776368

```

as.factor(company)179 2.072e-04 6.588e-04 0.314 0.753303
as.factor(company)180 1.708e-04 6.232e-04 0.274 0.784200
as.factor(company)181 -3.230e-04 5.904e-04 -0.547 0.584482
as.factor(company)182 -7.514e-04 6.967e-04 -1.078 0.281326
as.factor(company)183 -2.072e-04 6.254e-04 -0.331 0.740526
as.factor(company)184 2.891e-04 6.307e-04 0.458 0.646834
as.factor(company)185 8.522e-04 6.131e-04 1.390 0.165149
as.factor(company)186 5.084e-04 5.983e-04 0.850 0.395860
as.factor(company)187 -2.312e-04 6.991e-04 -0.331 0.741043
as.factor(company)188 4.003e-04 6.093e-04 0.657 0.511488
as.factor(company)189 -1.035e-04 5.946e-04 -0.174 0.861876
as.factor(company)190 3.679e-04 7.011e-04 0.525 0.599955
as.factor(company)191 -1.373e-04 6.606e-04 -0.208 0.835495
as.factor(company)192 -1.007e-03 4.908e-04 -2.051 0.040809 *
as.factor(company)193 -9.835e-05 8.430e-04 -0.117 0.907171
as.factor(company)194 -4.426e-04 5.960e-04 -0.743 0.458065
as.factor(company)195 -8.037e-04 4.908e-04 -1.638 0.102128
as.factor(company)196 -4.534e-04 6.112e-04 -0.742 0.458515
as.factor(company)197 -4.838e-05 8.615e-04 -0.056 0.955239
as.factor(company)199 1.341e-03 6.109e-04 2.196 0.028533 *
as.numeric(nib) -5.514e-05 5.405e-05 -1.020 0.308141
as.numeric(nbmeeting) -7.041e-07 1.609e-05 -0.044 0.965122

```

---  
Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.0006681 on 520 degrees of freedom  
(29 observations deleted due to missingness)  
Multiple R-squared: 0.9883, Adjusted R-squared: 0.9839  
F-statistic: 225 on 195 and 520 DF, p-value: < 2.2e-16

## Appendix 8: Tobin's Q output with time effect

The following output shows the results for Tobin's Q with taking time into consideration

Call:

```
lm(formula = TobinQ ~ +as.numeric(Audit) + (as.numeric(board_size)) +
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +
  as.numeric(employees) + as.factor(company) + as.factor(Year) +
  as.numeric(nib) + as.numeric(nbmeeting), data = mydata)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.0070201	-0.0001222	0.0000000	0.0001178	0.0091037

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	1.028e-03	1.371e-03	0.750	0.453637
as.numeric(Audit)	-8.391e-05	1.020e-03	-0.082	0.934488
as.numeric(board_size)	3.087e-05	4.701e-05	0.657	0.511650
as.factor(industry)1	4.344e-05	4.053e-04	0.107	0.914679
as.numeric(leverage)	-2.320e-07	2.009e-07	-1.155	0.248814
as.numeric(nbcom)	-5.579e-05	8.903e-05	-0.627	0.531210
as.numeric(employees)	8.656e-08	2.484e-07	0.349	0.727593
as.factor(company)2	5.422e-05	7.345e-04	0.074	0.941181
as.factor(company)3	3.871e-04	4.309e-04	0.898	0.369494
as.factor(company)4	9.922e-04	6.110e-04	1.624	0.105032
as.factor(company)5	-1.681e-04	4.542e-04	-0.370	0.711505
as.factor(company)6	-8.303e-05	6.326e-04	-0.131	0.895620
as.factor(company)7	-6.572e-04	5.632e-04	-1.167	0.243799
as.factor(company)8	-3.224e-04	6.014e-04	-0.536	0.592157
as.factor(company)9	3.951e-05	5.913e-04	0.067	0.946756
as.factor(company)10	6.497e-03	6.474e-04	10.036	< 2e-16 ***
as.factor(company)11	2.250e-03	5.761e-04	3.906	0.000106 ***
as.factor(company)12	3.070e-04	6.002e-04	0.511	0.609287
as.factor(company)13	1.038e-03	6.018e-04	1.725	0.085122 .
as.factor(company)14	4.031e-04	5.964e-04	0.676	0.499459
as.factor(company)15	9.006e-03	7.084e-04	12.713	< 2e-16 ***
as.factor(company)16	-7.497e-04	4.363e-04	-1.718	0.086343 .
as.factor(company)17	9.058e-04	8.460e-04	1.071	0.284784
as.factor(company)18	1.327e-04	6.178e-04	0.215	0.830019
as.factor(company)19	-1.448e-04	5.939e-04	-0.244	0.807520
as.factor(company)20	-7.351e-04	4.499e-04	-1.634	0.102888
as.factor(company)21	-1.985e-04	5.904e-04	-0.336	0.736919
as.factor(company)22	2.994e-04	8.465e-04	0.354	0.723710
as.factor(company)23	1.676e-04	6.466e-04	0.259	0.795561
as.factor(company)24	1.310e-04	6.155e-04	0.213	0.831489
as.factor(company)25	-4.895e-04	8.679e-04	-0.564	0.572998



as.factor(company)26	-2.694e-04	6.160e-04	-0.437	0.662034
as.factor(company)27	1.141e-03	6.083e-04	1.875	0.061294 .
as.factor(company)28	-2.402e-04	6.404e-04	-0.375	0.707796
as.factor(company)29	1.081e-03	6.006e-04	1.799	0.072539 .
as.factor(company)30	-3.473e-04	6.089e-04	-0.570	0.568701
as.factor(company)32	3.225e-04	6.043e-04	0.534	0.593798
as.factor(company)33	1.327e-03	7.014e-04	1.893	0.058979 .
as.factor(company)34	5.088e-04	6.005e-04	0.847	0.397279
as.factor(company)35	2.657e-03	6.028e-04	4.408	1.27e-05 ***
as.factor(company)36	-5.447e-04	8.490e-04	-0.642	0.521409
as.factor(company)37	1.512e-05	6.112e-04	0.025	0.980269
as.factor(company)38	-1.247e-04	5.915e-04	-0.211	0.833131
as.factor(company)39	-5.642e-04	6.019e-04	-0.937	0.348969
as.factor(company)40	-6.951e-04	7.290e-04	-0.954	0.340731
as.factor(company)41	-2.514e-04	5.899e-04	-0.426	0.670120
as.factor(company)42	-9.141e-04	7.308e-04	-1.251	0.211543
as.factor(company)43	8.222e-05	6.503e-04	0.126	0.899445
as.factor(company)44	1.228e-04	6.352e-04	0.193	0.846835
as.factor(company)45	9.933e-04	5.905e-04	1.682	0.093160 .
as.factor(company)46	7.134e-04	8.429e-04	0.846	0.397734
as.factor(company)47	-1.916e-04	6.071e-04	-0.316	0.752480
as.factor(company)48	2.182e-03	6.007e-04	3.633	0.000308 ***
as.factor(company)49	-2.582e-04	6.037e-04	-0.428	0.668990
as.factor(company)50	-2.935e-04	6.294e-04	-0.466	0.641116
as.factor(company)51	1.075e-03	6.057e-04	1.775	0.076474 .
as.factor(company)52	-3.854e-04	4.594e-04	-0.839	0.401867
as.factor(company)53	-3.560e-04	5.420e-04	-0.657	0.511553
as.factor(company)54	-1.968e-05	6.999e-04	-0.028	0.977580
as.factor(company)55	3.998e-03	8.451e-04	4.731	2.89e-06 ***
as.factor(company)56	3.299e-04	6.137e-04	0.538	0.591099
as.factor(company)57	8.410e-04	8.469e-04	0.993	0.321172
as.factor(company)59	-4.784e-04	6.965e-04	-0.687	0.492498
as.factor(company)60	1.365e-03	6.099e-04	2.238	0.025648 *
as.factor(company)61	-7.305e-04	5.986e-04	-1.220	0.222848
as.factor(company)62	-2.083e-05	5.902e-04	-0.035	0.971859
as.factor(company)63	-2.156e-04	6.048e-04	-0.356	0.721669
as.factor(company)64	8.639e-04	6.185e-04	1.397	0.163048
as.factor(company)65	-4.152e-04	6.337e-04	-0.655	0.512605
as.factor(company)66	-2.423e-04	6.228e-04	-0.389	0.697446
as.factor(company)67	-3.733e-04	8.429e-04	-0.443	0.658015
as.factor(company)68	1.761e-03	6.027e-04	2.922	0.003626 **
as.factor(company)69	-4.301e-04	6.059e-04	-0.710	0.478140
as.factor(company)70	7.773e-03	4.363e-04	17.817	< 2e-16 ***
as.factor(company)71	1.157e-03	7.423e-04	1.558	0.119800
as.factor(company)73	1.039e-04	7.523e-04	0.138	0.890226
as.factor(company)74	1.066e-03	5.922e-04	1.801	0.072301 .
as.factor(company)75	-2.907e-04	4.635e-04	-0.627	0.530884
as.factor(company)76	2.997e-03	6.227e-04	4.813	1.96e-06 ***
as.factor(company)77	-5.398e-04	5.328e-04	-1.013	0.311415
as.factor(company)78	-7.140e-04	4.522e-04	-1.579	0.114944

as.factor(company)79	2.472e-03	4.598e-04	5.377	1.15e-07	***
as.factor(company)80	1.425e-03	6.045e-04	2.358	0.018737	*
as.factor(company)81	7.662e-05	6.010e-04	0.128	0.898591	
as.factor(company)82	1.951e-05	5.898e-04	0.033	0.973625	
as.factor(company)83	2.388e-04	6.060e-04	0.394	0.693651	
as.factor(company)84	3.550e-04	6.076e-04	0.584	0.559318	
as.factor(company)85	2.445e-03	5.983e-04	4.086	5.09e-05	***
as.factor(company)86	-6.238e-04	7.104e-04	-0.878	0.380250	
as.factor(company)87	1.667e-03	6.002e-04	2.778	0.005675	**
as.factor(company)88	-3.850e-04	5.998e-04	-0.642	0.521207	
as.factor(company)89	6.390e-04	8.385e-04	0.762	0.446399	
as.factor(company)90	1.764e-03	6.004e-04	2.939	0.003439	**
as.factor(company)91	5.375e-05	8.467e-04	0.063	0.949412	
as.factor(company)92	-2.212e-04	5.970e-04	-0.370	0.711165	
as.factor(company)93	1.975e-03	7.023e-04	2.813	0.005102	**
as.factor(company)94	5.733e-04	6.036e-04	0.950	0.342650	
as.factor(company)95	1.905e-03	6.531e-04	2.917	0.003694	**
as.factor(company)96	-1.389e-04	6.054e-04	-0.229	0.818599	
as.factor(company)97	8.936e-04	8.496e-04	1.052	0.293335	
as.factor(company)98	-2.703e-04	6.010e-04	-0.450	0.653050	
as.factor(company)99	-8.433e-04	4.367e-04	-1.931	0.054031	.
as.factor(company)100	-8.036e-04	4.403e-04	-1.825	0.068573	.
as.factor(company)101	-8.300e-04	4.399e-04	-1.887	0.059746	.
as.factor(company)102	4.591e-04	5.177e-04	0.887	0.375542	
as.factor(company)103	-7.535e-05	6.202e-04	-0.121	0.903345	
as.factor(company)104	-4.968e-04	6.913e-04	-0.719	0.472704	
as.factor(company)105	-1.291e-05	5.967e-04	-0.022	0.982750	
as.factor(company)106	1.628e-05	6.490e-04	0.025	0.980001	
as.factor(company)107	5.511e-04	6.101e-04	0.903	0.366779	
as.factor(company)108	-5.932e-04	7.297e-04	-0.813	0.416600	
as.factor(company)109	1.739e-04	6.468e-04	0.269	0.788075	
as.factor(company)110	-3.544e-04	8.463e-04	-0.419	0.675543	
as.factor(company)111	-9.484e-06	5.889e-04	-0.016	0.987156	
as.factor(company)112	-3.539e-04	6.931e-04	-0.511	0.609897	
as.factor(company)113	-3.041e-04	5.988e-04	-0.508	0.611838	
as.factor(company)114	3.020e-03	6.025e-04	5.013	7.36e-07	***
as.factor(company)115	-5.187e-04	8.448e-04	-0.614	0.539517	
as.factor(company)116	5.422e-03	8.639e-04	6.277	7.33e-10	***
as.factor(company)117	-8.438e-04	4.388e-04	-1.923	0.055060	.
as.factor(company)118	8.452e-04	8.355e-04	1.012	0.312170	
as.factor(company)119	5.197e-04	7.034e-04	0.739	0.460322	
as.factor(company)120	1.954e-07	5.915e-04	0.000	0.999736	
as.factor(company)121	-3.889e-04	5.871e-04	-0.663	0.507940	
as.factor(company)122	3.154e-04	5.896e-04	0.535	0.592859	
as.factor(company)123	-1.957e-04	5.916e-04	-0.331	0.740942	
as.factor(company)124	-6.256e-04	7.371e-04	-0.849	0.396453	
as.factor(company)125	8.786e-05	1.332e-03	0.066	0.947441	
as.factor(company)126	-9.426e-04	6.126e-04	-1.539	0.124504	
as.factor(company)127	-2.230e-04	8.571e-04	-0.260	0.794834	
as.factor(company)128	4.416e-04	4.226e-04	1.045	0.296507	

```

as.factor(company)129 -6.614e-04 4.917e-04 -1.345 0.179140
as.factor(company)130 9.804e-04 1.317e-03 0.744 0.457101
as.factor(company)131 1.434e-03 6.099e-04 2.352 0.019070 *
as.factor(company)132 2.481e-04 5.893e-04 0.421 0.673939
as.factor(company)134 3.156e-04 6.172e-04 0.511 0.609315
as.factor(company)135 -9.533e-04 5.830e-04 -1.635 0.102630
as.factor(company)136 -1.630e-04 6.454e-04 -0.253 0.800670
as.factor(company)137 6.113e-02 6.003e-04 101.831 < 2e-16 ***
as.factor(company)138 -8.176e-05 6.070e-04 -0.135 0.892905
as.factor(company)139 -2.215e-06 4.349e-04 -0.005 0.995939
as.factor(company)140 -8.309e-05 6.113e-04 -0.136 0.891933
as.factor(company)141 3.574e-03 7.027e-04 5.086 5.12e-07 ***
as.factor(company)142 -7.853e-04 4.429e-04 -1.773 0.076825 .
as.factor(company)143 -6.148e-04 6.030e-04 -1.020 0.308378
as.factor(company)144 -2.188e-04 6.043e-04 -0.362 0.717496
as.factor(company)145 3.360e-05 8.481e-04 0.040 0.968415
as.factor(company)146 -5.722e-04 4.251e-04 -1.346 0.178906
as.factor(company)147 1.924e-03 6.765e-04 2.844 0.004627 **
as.factor(company)153 -2.756e-04 5.917e-04 -0.466 0.641521
as.factor(company)154 -1.116e-04 7.074e-04 -0.158 0.874741
as.factor(company)155 1.090e-03 5.911e-04 1.843 0.065844 .
as.factor(company)156 1.691e-03 6.506e-04 2.599 0.009606 **
as.factor(company)157 1.070e-03 5.913e-04 1.809 0.070955 .
as.factor(company)158 6.191e-05 6.006e-04 0.103 0.917931
as.factor(company)159 4.030e-04 6.054e-04 0.666 0.505872
as.factor(company)160 -2.955e-04 7.166e-04 -0.412 0.680230
as.factor(company)161 9.004e-04 6.204e-04 1.451 0.147299
as.factor(company)162 2.024e-03 5.911e-04 3.424 0.000666 ***
as.factor(company)163 1.308e-03 1.337e-03 0.978 0.328343
as.factor(company)164 -1.505e-04 5.861e-04 -0.257 0.797426
as.factor(company)165 -8.750e-04 4.287e-04 -2.041 0.041748 *
as.factor(company)166 1.764e-04 6.905e-04 0.255 0.798516
as.factor(company)167 -1.778e-05 4.427e-04 -0.040 0.967971
as.factor(company)168 -6.565e-04 5.186e-04 -1.266 0.206120
as.factor(company)169 1.154e-03 6.231e-04 1.852 0.064533 .
as.factor(company)170 4.564e-04 5.939e-04 0.768 0.442570
as.factor(company)171 9.702e-05 5.985e-04 0.162 0.871284
as.factor(company)172 1.203e-03 8.382e-04 1.436 0.151660
as.factor(company)173 -3.532e-04 5.922e-04 -0.596 0.551111
as.factor(company)174 -5.145e-04 8.337e-04 -0.617 0.537411
as.factor(company)175 -7.311e-04 7.275e-04 -1.005 0.315435
as.factor(company)176 -2.437e-05 5.840e-04 -0.042 0.966729
as.factor(company)178 -1.572e-04 5.940e-04 -0.265 0.791396
as.factor(company)179 3.132e-04 6.510e-04 0.481 0.630593
as.factor(company)180 2.311e-04 6.170e-04 0.375 0.708141
as.factor(company)181 -3.066e-04 5.834e-04 -0.526 0.599421
as.factor(company)182 -7.833e-04 6.900e-04 -1.135 0.256832
as.factor(company)183 -1.248e-04 6.183e-04 -0.202 0.840079
as.factor(company)184 2.834e-04 6.231e-04 0.455 0.649429
as.factor(company)185 8.792e-04 6.063e-04 1.450 0.147656

```

```

as.factor(company)186 4.601e-04 5.912e-04 0.778 0.436819
as.factor(company)187 -2.628e-04 6.903e-04 -0.381 0.703618
as.factor(company)188 4.750e-04 6.022e-04 0.789 0.430553
as.factor(company)189 -6.961e-05 5.875e-04 -0.118 0.905723
as.factor(company)190 4.324e-04 6.945e-04 0.623 0.533793
as.factor(company)191 -3.344e-05 6.540e-04 -0.051 0.959239
as.factor(company)192 -8.767e-04 4.863e-04 -1.803 0.072006 .
as.factor(company)193 4.287e-05 8.342e-04 0.051 0.959038 .
as.factor(company)194 -4.267e-04 5.890e-04 -0.724 0.469107
as.factor(company)195 -7.228e-04 4.861e-04 -1.487 0.137640
as.factor(company)196 -4.088e-04 6.042e-04 -0.677 0.498962
as.factor(company)197 7.504e-05 8.520e-04 0.088 0.929853
as.factor(company)199 1.352e-03 6.035e-04 2.241 0.025436 *
as.factor(Year)2014 2.631e-04 8.500e-05 3.095 0.002072 **
as.factor(Year)2015 1.476e-04 8.749e-05 1.687 0.092258 .
as.factor(Year)2016 -8.358e-06 8.976e-05 -0.093 0.925847
as.factor(Year)2017 -2.215e-05 8.717e-05 -0.254 0.799559
as.numeric(nib) -5.205e-05 5.553e-05 -0.937 0.349034
as.numeric(nbmeeting) 1.378e-05 1.708e-05 0.807 0.419889

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.0006594 on 516 degrees of freedom  
(29 observations deleted due to missingness)

Multiple R-squared: 0.9887, Adjusted R-squared: 0.9843

F-statistic: 226.4 on 199 and 516 DF, p-value: < 2.2e-16

## Appendix 9: Tobin's Q OLS output

The following output ignored both time and companies' effect with Tobin's Q.

Call:

```
lm(formula = TobinQ ~ +as.numeric(Audit) + (as.numeric(board_size)) +  
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
  as.numeric(employees) + as.numeric(nib) + as.numeric(nbmeeting),  
  data = mydata)
```

Residuals:

```
   Min      1Q  Median      3Q      Max  
-0.003914 -0.001401 -0.000463  0.000433  0.067314
```

Coefficients:

```
              Estimate Std. Error t value Pr(>|t|)  
(Intercept)      6.293e-03  1.840e-03   3.420 0.000662 ***  
as.numeric(Audit)  9.594e-04  1.512e-03   0.634 0.526002  
as.numeric(board_size) -1.797e-04  1.608e-04  -1.118 0.263959  
as.factor(industry)1 -4.429e-04  5.316e-04  -0.833 0.405046  
as.numeric(leverage) -4.881e-06  9.563e-07  -5.104 4.27e-07 ***  
as.numeric(nbcom)   -8.239e-04  2.621e-04  -3.144 0.001737 **  
as.numeric(employees) 1.365e-06  9.247e-07   1.476 0.140423  
as.numeric(nib)      5.035e-05  1.845e-04   0.273 0.785069  
as.numeric(nbmeeting) 3.065e-05  7.801e-05   0.393 0.694512  
---
```

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.005117 on 707 degrees of freedom

(29 observations deleted due to missingness)

Multiple R-squared: 0.06586, Adjusted R-squared: 0.05529

F-statistic: 6.231 on 8 and 707 DF, p-value: 8.4e-08

## Appendix 10: Tobin's Q fixed model

This is the fixed model that takes companies' effect as factors.

```
fixed <-  
plm(TobinQ~as.numeric(Audit)+(as.numeric(board_size))+as.factor(industry)+as.nu  
meric(leverage)+as.numeric(nbcom)+as.numeric(employees)+as.numeric(nib)+as.nu  
meric(nbmeeting), index=c("company"),data=mydata,model="between")  
summary(fixed)
```

Oneway (individual) effect Between Model

Call:

```
plm(formula = TobinQ ~ as.numeric(Audit) + (as.numeric(board_size)) +  
  as.factor(industry) + as.numeric(leverage) + as.numeric(nbcom) +  
  as.numeric(employees) + as.numeric(nib) + as.numeric(nbmeeting),  
  data = mydata, model = "between", index = c("company"))
```

Unbalanced Panel: n = 188, T = 1-5, N = 716

Observations used in estimation: 188

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.00321954	-0.00134079	-0.00034736	0.00050149	0.05775967

Coefficients:

	Estimate	Std. Error	t-value	Pr(> t )
(Intercept)	6.1709e-03	3.3011e-03	1.8693	0.063212 .
as.numeric(Audit)	4.9796e-04	2.5953e-03	0.1919	0.848060
as.numeric(board_size)	-1.5570e-04	3.0414e-04	-0.5119	0.609330
as.factor(industry)1	-6.7251e-04	9.0663e-04	-0.7418	0.459200
as.numeric(leverage)	-5.8296e-06	1.9640e-06	-2.9682	0.003405 **
as.numeric(nbcom)	-9.2654e-04	5.1444e-04	-1.8011	0.073377 .
as.numeric(employees)	2.0074e-06	1.7668e-06	1.1362	0.257400
as.numeric(nib)	8.3892e-05	3.6113e-04	0.2323	0.816566
as.numeric(nbmeeting)	9.0999e-05	1.7099e-04	0.5322	0.595259

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.0040475

Residual Sum of Squares: 0.0037148

R-Squared: 0.082192

Adj. R-Squared: 0.041173

F-statistic: 2.00374 on 8 and 179 DF, p-value: 0.04837

## Appendix 11: Tobin's Q f-test

This is F test to show which model is better (fixed model or ordinary least square method).

F test for individual effects

data: TobinQ ~ as.numeric(Audit) + (as.numeric(board\_size)) + as.factor(industry) +

...

F = 1.3501, df1 = 528, df2 = 179, p-value = 0.008902

alternative hypothesis: significant effects