



Impact of the proprietary cost on frequency of voluntary disclosure in R&D and non-R&D intensive companies

Paulina Konopacka 580655

Supervisor: Dr. P.Y.E. Edith Leung

Erasmus University Rotterdam
Erasmus School of Economics Master Thesis Accounting, Auditing and Control

Abstract

This thesis examines how proprietary cost affects the level of voluntary disclosure in R&D and non-R&D intensive companies. Proprietary cost is measured using number of patent applications and frequency of voluntary disclosure is measured using number of annual management earnings forecasts. Higher number of patents indicate that firms have higher proprietary cost. The sample consists of 3498 observations from 11 industries. The observations present 432 U.S. firms over ten years period from 2010 until 2019. This study is the first which explores the relation between frequency of the disclosure and proprietary cost using the management earnings forecasts.

My results support this hypothesis and indicate that proprietary cost has a negative impact on the level of voluntary disclosure. I also tested whether R&D intensity affects the frequency of voluntary disclosure. I find that high R&D intensive firms disclose less than low R&D intensive firms. The main reason of that is because R&D intensive firms have higher level of the competition and this leads that proprietary cost increase. In this thesis there is also examined the effect of the patents on the R&D intensity and level of disclosure. However, this relation is not significant and it needs further research.

Table of Contents

Abstract.....	1
1 Introduction	1
2 Theoretical background and hypothesis development.....	3
2.1 Mandatory and voluntary disclosure	3
2.2 Disincentive of voluntary disclosure.....	5
2.3 Literature review	6
2.4 Hypothesis development	8
3 Research design.....	10
3.1 Dependent variable.....	10
3.2 Independent variable - proprietary cost.....	10
3.3 Control variables	11
3.3.1 Firm size (SIZE)	11
3.3.2 Return on assets (ROA)	12
3.3.3 Number of analyst following the company (ANALYST)	12
3.3.4 Leverage (LEVERAGE).....	12
3.3.5 Ownership structure (OWNER%)	13
3.4 Regression model.....	13
4 Results	14
4.1 Descriptive Statistics.....	14
4.2 Pearson correlations	17
4.3 Regression analysis	19
5 Conclusions	26
6 Appendix	28
Appendix 6.1 Libby boxes	28
Appendix 6.2 List of variables	29
Appendix 6.3 Descriptive statistics before data winsorization	30
Appendix 6.4 Number of firms per year	31
References.....	32

1 Introduction

During the last years, across many countries there was a significant increase of the number of companies applying for patents. The main reason for that was that patents support the innovation and growth in economies. Development of technology and innovation had a big impact the patents gaining so much importance and popularity across multiple industries. Many companies decide to use patents as a form of protection from competitors because the product which is patented is protected from being replicated by competitors. It is important to note that number of patents may be different across industries. R&D intensive firms are a good example of that. For those types of firm patents play a crucial role as innovation is important to them and because of the high level of the competition they can use patents as a form of protection.

Patents and disclosure are available to the public. Patents provide the right for the product to the owner who can use it exclusively and they are used to protect company's ownership. On the other side, disclosures pose the information which is available to the public and everyone can use it freely. Disclosures are important for the companies because they help and support the right functioning of the market. They are also beneficial for the firms because they reduce the information asymmetry and companies can be more transparent to the outsiders. Another important factor is that disclosures help to diminish cost of capital and this leads to increase in the firm liquidity. It is beneficial to the companies to do disclosures because makes them more credible for others. On the other hand, because disclosures contain a lot of information about the company they might be very beneficial to the competitors.

Prior research examines the effect of the competition on the level of voluntary disclosure. Darrough and Stoughton (1990), Orchun (2019) and Verrecchia (1983) indicate that companies for which disclosure benefits competitors might be more reluctant to provide them. Jones (2008) in her paper investigates what drives R&D intensive firms to provide voluntary disclosure and which types of the disclosure about R&D activities are presented. She focuses on 119 R&D intensive firms and presents that proprietary cost have a negative impact on the disclosure. Healy and Palepu (2001) in their paper presented six motives of the voluntary disclosure. One of them is the proprietary cost hypothesis which indicates that companies which have higher proprietary cost provide less disclosure contrary to the companies which have smaller proprietary cost. However, the amount of evidence which covers that topic is quite limited (Jones, 2008; Verrecchia, 1983). To expand research paper by Jones, 2008 I focus on

the frequency of voluntary disclosure in non-R&D intensive firms. I have included non-R&D intensive firms because those firms characterize lower proprietary cost and consequently this firms provide more voluntary disclosure to the outsiders than R&D intensive firms. To contribute to this literature, I study the following research question: What is the impact of proprietary cost on the frequency of voluntary disclosure in R&D and non-R&D intensive firms?

Voluntary disclosures are measured using the annual number of management earnings forecasts. This is because management earnings forecasts in a straightforward way presents how often a company provides voluntary disclosures to the outsiders. Also, prior researchers identify the management forecast as one of the most relevant and common types of the voluntary information provided by companies (Healy and Palepu 2001, Pownell et al, 1993). Thus, it is important to examine whether management earnings forecasts are affected by proprietary cost. Proprietary cost is hard to measure and observe. Thus, to study the link between the proprietary cost and frequency of voluntary disclosure I measure the proprietary cost using the number of patents application disclosed by the companies in a given year following the studies provided by Jones (2008).

My sample includes 432 unique firms with 3 498 observations over 2010-2019. The main contribution of the paper is that data that is up to date and I can reconfirm prior studies about proprietary cost hypothesis and impact of the frequency of voluntary disclosure. Another important contribution is that this thesis includes data which provide longer time period. Jones, 2008 in her paper collected only one year data which were related to R&D disclosure. This thesis includes ten years of most recent data and help verify whether specific years have an impact on the results. It is also important to examine the hypothesis including several years because with the fast development of technology and innovation R&D environment is changing rapidly so it is interesting to see data dependency. Apart from that the variables of the interest are measured with the different proxies. In my thesis frequency of voluntary disclosure is measured using management earnings forecasts which are extracted from the Wharton Research Data Service database. Jones (2008) in her paper use hand collecting data which can be more prone for measurement error. In my thesis to measure how proprietary cost have impact on the level of disclosure I include both types of the industries those which are high R&D intensive and low R&D intensive.

The thesis paper proceeds as follows. Chapter 1 depicts introduction of the paper. Chapter 2 presents prior research regarding voluntary disclosure and proprietary cost. This chapter also develops the hypotheses. Section 3 describes the research methodology. This section also discusses the sample selection and design of the research. Section 4 presents the empirical results and interpretations. Section 5 provides the conclusion of the paper, limitation and possibilities for future research.

2 Theoretical background and hypothesis development

In this section I will review the existing literature related to the proprietary cost and voluntary disclosure in high and low R&D intensive firms. Firstly, I will focus on mandatory and voluntary disclosures and what demotivates companies to provide voluntary disclosure. Next, I will describe the proprietary cost and number of patent applications which measure this cost. Lastly, I will review existing literature and formulate the hypothesis.

2.1 Mandatory and voluntary disclosure

Disclosure is a form of communication between a company and outside investors. In disclosure management provides financial and non-financial information to the outsiders (Gibbins et al, 1990). Users of disclosure express the need to improve the quality and quantity of the disclosure (Beyer et al 2010; Li, 2010). One reason for that is because managers possess more company related information and it is hard for outsiders to evaluate company performance and possibilities for future investment (Bayer et al, 2010; Shehata, 2013). Consequently, there is information asymmetry between managers and investors. (Graham et al, 2005). This is related to the agency theory when investors assign the managers responsibilities to make a decision on the behalf of stakeholders. Thus, investors do not take an active part in daily business activities (Healy et al, 2001). Also, the managers have incentives to make a decision in their own interests instead of the interest of investors (Healy et al, 2001; Raith, 2003). To mitigate these issues related to information asymmetry, investors call for more accurate and frequent disclosure.

Every company is responsible for deciding how much of the information they disclose. Some companies provide only mandatory disclosure, others decide to provide additional information known as voluntary disclosure (He, 2019). Consequently, we can distinguish two types of disclosure: mandatory and voluntary disclosure. To comply with law and regulations, all listed companies are obligated to provide mandatory disclosure about the company performance (Gunawan et al, 2019; Lang et al, 1996). This type of disclosure is controlled by regulatory organizations such as FASB, IASB etc. (Campell et al, 2021; Dye et al, 2001). In mandatory disclosure companies are forced by regulators, law and accounting setters to disclose information about the company including both bad news and good news (Verrecchia, 2001). Researchers suggest that imposing the minimum level of regulation for disclosure may mitigate the gap between informed and uninformed investors (Healy et al, 1999; Watts et al, 1986).

Voluntary disclosure is a voluntary decision of managers whether to disclose information about the company or not (Fishman et al, 2003; Gunaman et al, 2015). One of the reasons for providing voluntary disclosures by companies is to cover the limitations of the mandatory disclosure. This is because investors express the needs for more disclosure about the company performance (Graham et al, 2005). Voluntary disclosures can be qualitative and quantitative. They are disclosed through various channels such as management earnings forecasts, press releases, conference calls, analyst meetings and social media (Hirst et al, 2008; He et al, 2019; Einhorn, 2005). Voluntary disclosure contains additional information about the firm's operating activities and performance. Thus, a key reason for voluntary disclosure is managers desire to create more transparent reporting (Healy et al, 2000). Moreover, managers want to help investors to understand the information which they disclose because the deficiency of the understanding can bring some negative consequences, for instance underpricing of a company stock (Beyer et al., 2010).

Many researchers try to examine how these two types of disclosure are related whether they are complementary or substitute each other. Some researchers state that when regulators impose additional requirements regarding the mandatory disclosure the companies will provide less voluntary disclosure (Verrecchia, 1982). However, others argue that when regulators provide more restriction on the mandatory disclosure this motivates companies to provide more disclosures. Thus, providing a voluntary disclosure is linked with the requirements which are imposed on the mandatory disclosure by regulators and with the environment in which

a company operates (Einhorn, 2004). These two types of disclosures are different from each other but both crucial for investors and other users of disclosures (Cheynel, 2013; Einhorn, 2004).

2.2 Disincentive of voluntary disclosure

Scott (1994) describes incentives and disincentives to disclose private information to the external users. One of the reasons that managers will disclose less is related to managers self-interest purposes which indicate that managers provide the disclosure only when they gain benefit from that (Nagar et al, 2003). Another important reason for providing less disclosure by the companies is that voluntary disclosure can affect the company's position in the market in favor of the competitors (Jones, 2007; Lang 2014). Thus, it is important to examine what drives the managers to disclose their private information. Graham et al (2005) distinguishes four types of costs which have a negative impact on voluntary disclosure. These costs are: litigation cost, proprietary cost, agency cost and political cost. Below, I briefly describe each type of the cost and how it affects the voluntary disclosure in a negative way.

- Litigation cost is the cost that the company might have in case of potential lawsuits. This cost can influence companies' choice of voluntary disclosure in both ways (Graham et al, 2005). According to the research paper by Skinner (1994), managers provide voluntary disclosure of bad news because they can be held responsible if they did not disclose this information and then can be sued by stakeholders. Thus, they want to avoid this situation and provide voluntary disclosure. High litigation costs can also discourage companies from providing future voluntary disclosure. According to Graham et al (2005), firms which are new in the market and young are more likely to face litigation costs. This type of cost depends on the type of the industry, for instance firms which belong to the technology industry have higher litigation costs.
- Agency cost occurs when the interest of the principal (manager) is not in line with the interest of the agent (shareholder). This is because the manager wants to maximize his own wealth and the shareholder wants to maximize the interest of the company. Thus, it is hard to encourage managers to provide more information about the company because

managers who fulfill their own incentives may also disclose information which is useless for investors (Graham et al, 2005).

- Political cost happens when companies do not disclose information because they do not want to be threatened by regulators. One example of companies that deal with this type of the cost are the companies which have more insiders on board. Those companies will less likely provide voluntary disclosure because they do not want to draw the attention of the regulators when they disclose private information (Graham et al, 2005; Makar et al, 1996).
- Proprietary cost is present when firms in their disclosure reveal strategic information to the competitors that can be used to the disclosing firm's detriment (Luo et al, 2006). Voluntary disclosure can be beneficial for the company because it improves the company valuation in the market, however it also motivates new competitors to come to the market (Li, 2010). The proprietary cost reduces the disclosure especially in the small firms (Graham et al, 2005). High proprietary costs characterize innovative companies or those kinds of firms which invest in innovation (Lang et al 2014). Thus, those types of firms provide less voluntary disclosure than companies that innovation is less important. One reason is that companies which innovate a lot have high levels of competition and their disclosure can benefit firms which they compete with (Gu et al, 2003).

2.3 Literature review

Prior research indicates that proprietary cost is negatively related to the level of voluntary disclosure provided by the companies (Berger et al 2007; Harris et al, 1998; Lang et al, 2010; Verrechia, 1983). Many firms decide to disclose only in a situation when cost of the disclosure is lower than benefits of providing them. However, some of them operate in environment when level of the competition is high and they need to decide whether the disclosure will bring benefits or costs for them. Jones (2007) in her paper examines the relationship between the proprietary cost and the frequency of the R&D related disclosure in R&D intensive firms. R&D intensive firms are specific types of the firms when innovation and development are crucial for the good functioning in the market. In her analysis she used patents as a measure of proprietary cost and assumes that higher number of patent applications is

associated with higher proprietary costs. Jones (2007) finds that companies provide plenty of information about R&D activity however when proprietary cost is present they diminish the number of disclosure.

Contrary to Jones (2008), Ding et al. (2004) found out that Canadian high-tech companies provide more non-financial disclosure to diminish the information asymmetry. They conduct the research using the French and Canadian high-tech firms. Also, they conclude that Canadian firms provide more disclosure about R&D expenditure than France firms. Thus, the amount of disclosure does not depend on proprietary cost but on culture and market characteristics.

Guo et al (2005) in their research paper looked at IPO valuation in biotech firms and concluded that patent protection is more important for investors than for the owners of the company. According to their research paper those IPOs which have more patent protection perform worse in a long period than those which have smaller numbers of patents. In line with that Harabi (1995) based on a survey conducted among 355 R&D Swiss experts, concluded that patent applications contain a lot of valuable information including identification of the inventor and detailed description of the patented products. This type of information can be used by investors but it also holds a high value for the competitors (Healy and Palepu, 2001). Generally, firms which have more patents are more innovative therefore information included in their disclosures is perceived by the competitors as very valuable (Guo et al, 2005). Based on the work of all the above researchers, patents might be negatively associated with level of voluntary disclosure.

On the other hand, using patents serves various benefits to the company. Patents provide a form of protection (Nicholas, 2011). Another positive side of patents is signaling that the company has a high level of skills and knowledge. Firms that have advanced technical abilities often use patents to indicate that they are more skillful than their competitors. As a result, other companies will not be able to copy their R&D strategy (Ethiraj et al; 2008, Entwistle, 1995). Patents can also prevent new companies from entering the same market by helping R&D intensive firms promote their strong competitive position in the industry (James, 2014). Hence, higher patenting activity could be associated with lower proprietary costs of disclosure.

Finally, all types of firms must operate in the environment when the proprietary cost is present (Harris et al, 1998, Verrecchia, 1983). Analyzing how proprietary cost is related to the

level of disclosure is very difficult in practice (Beyer et al 2007; Jones, 2007). To start, proprietary cost is hard to measure (Lang et al, 2014). Most researchers also agree that firms which have high proprietary costs disclose less information to the outsiders (Berger et al 2007; Jones, 2007). According to Verrecchia (1983), presence of proprietary cost is related to that companies provide only partial disclosure. It is also worth noting that firms which have high proprietary cost are more likely to favor good news in their disclosure (Berger et al 2007; Verrecchia, 1983). Competitive and technological advantage plays a primary role in high R&D intensive firms (James, 2014). Consequently, companies that decide to disclose may lose competitive advantage among competitors (Harabi, 1995; Polidoro et al, 2012). Thus, R&D firms are more likely to choose to disclose less information to outsiders. This holds especially true when related to information regarding new products (James, 2014). R&D intensive firms disclose less because they don't want to benefit their competitors, especially at the expense of their company's performance (Harabi, 1995). In line with previous studies, there is a difference in the level of the disclosure between the companies with different levels of R&D intensity.

2.4 Hypothesis development

In line with the literature review I can distinguish three hypotheses that are related to the proprietary cost (measured by number of patent applications) and frequency of voluntary disclosure which is measured using the number of annual management earnings forecasts. First hypothesis is linked to the number of patent applications and frequency of voluntary disclosure. Based on prior research, firms with more patents disclose less private information. This is because patents contain valuable information which can bring advantage to the company's rivals and bring negative consequences to the company which disclosed. The more patents a firm has, the stronger the negative impact in terms of attracting attention of the competitors and possibly harming the firm's position in the market. This leads to the following hypothesis:

H1: Number of patent applications is negatively related to the level of voluntary disclosure, holding all else constant.

Second hypothesis is related to the research paper provided by Jones (2007). She presented that R&D intensive companies disclose different types of R&D related information and proprietary cost negatively affect the level of disclosure. It is however worth noting that her results are based on the sample of only 122 high R&D intensive firms therefore may not hold true across other industries, for instance those which are low or less R&D intensive. It makes sense that R&D intensive firms face higher proprietary cost than low R&D intensive firms because they have more secret information which can harm firm long-term performance. This, leads to the second hypothesis:

H2: High R&D intensive firms provide less voluntary disclosure than low R&D intensive firms, holding all else constant.

Third hypothesis is related to association between patents and the level of R&D intensity on the disclosure. One of the reasons why companies use patents is to prevent competitors for using their products. Thus, patents pose a form of protection from competitors. Especially in environment when level of the competition is high and competitors can use the disclosure to obtain competitive advantage. R&D intensive firms are type of the firms where level of the competition is high and they try to operate in a way that competitors are not able to copy or duplicate their products. Thus, introduction of patents may encourage R&D intensive firms to provide more disclosure because their product are protected by patents. This leads to the third hypothesis:

H3: The number of patents reduces the negative relation between the R&D intensity and disclosure, holding all else constant.

3 Research design

In this chapter the research design and sample selection are explained. First of all, I present the description of dependent, independent and control variables. These variables are used to investigate the hypothesis. Moreover, I provide an explanation of the sample selection and present theoretical model.

3.1 Dependent variable

In my thesis I examine how the proprietary cost affects the level of voluntary disclosure. Thus, a dependent variable is the frequency of voluntary disclosure. I am interested in the frequency of the voluntary disclosure provided by a given company thus I am interested in the quantity of annual management earnings forecasts. To get the number of management earnings forecasts I extract data from the Wharton Research Data Service (WRDS). There from I/B/E/S Guidance I will get the data of the annual management earnings forecasts disclosed by a company in a given year. My sample include 3498 American publicly listed companies in 2010- 2019. One reason for providing management earnings forecasts by managers is because investors are not able to see entirely their actions (Trueman,1985). According to the research paper provided by Verrecchia (1983) proprietary cost is related with the voluntary disclosure along with management earnings forecasts. From my sample I excluded firms which make losses and outsiders. I also removed missing observations and checked whether there are any duplicates to mitigate the bias problem.

3.2 Independent variable - proprietary cost

Independent variable is the proprietary cost. One of the main disadvantages of measuring the proprietary cost is that it is hard to measure and observe this cost (Lang et al, 2014). To measure the proprietary cost I use number of patent applications (Aghion et al, 2005; Jones, 2007). To provide information about the number of patents disclosed by the companies

in a given year I use the United States Patent and Trademark Office (USPTO)¹. On this page we can find the number of patents disclose by the companies, which type of the patents they disclose and how many patents per year the company disclose. I concentrate on the quantity of the patents which the companies disclosed in each year.

In my thesis I would like to examine how the proprietary cost, which is measured by the number of patents, influences the level of the voluntary disclosure and whether there is a difference between firms which are part of the industry which characterize low or high R&D intensity. To group a firm to the right industry I use Standard Industrial Classification (SIC codes). After that I will measure the level of R&D intensity at industry level. Firms which characterize the high level of technology are R&D intensive. On the other hand, low R&D firms are low technology companies. To measure the R&D intensity I will use the approach provided by Jones (2007), where she divides R&D expenditures by sales.

3.3 Control variables

Control variables are useful because they can help to mitigate the correlated omitted variable problem. This problem is present because companies before they decide to provide voluntary disclosure face many different alternatives of providing a voluntary disclosure. Another reason for providing control variables is because there are many other factors which can influence the management's earnings forecasts. Thus, below I will provide the following control variables: firm size, return on assets, number of analysts following the company, leverage and ownership structure. To extract control variables, I will use the following datasets. I will use Compustat North America to extract data about R&D expenses and sales. In IBES summary I will extract ROA and number of analysts following the company.

3.3.1 Firm size (SIZE)

The first control variable is the firm size. According to the research paper provided by Lim et al (2007) larger companies face higher information asymmetry in comparison to the smaller firms. One solution to minimize the information asymmetry between the company and investors is by providing more private information to the outsiders. Consequently, the size of

¹ www.uspto.gov

the company and the level of voluntary disclosure are positively associated with each other (Buzby, 1975; Lim et al, 2007). Addition to that, firms which are larger are more bonded with the client by the contract, so they are less likely to be affected with the negative consequences of their voluntary disclosure. In this manner proprietary cost is lower for the firms which disclose (Prencipe, 2010). Jones (2007) provides evidence that R&D disclosure is related to the company size. Also, size of the firm has an impact on the number of patent applications. For instance, large firms can hire the people who will be responsible for application of the patents and advise companies about the patents (Bound et al, 1984). Consequently, I expect that larger firms provide more voluntary disclosure. In line with the previous studies, I will measure firm size following the Lim et al (2007) approach using the logarithm of total assets.

3.3.2 Return on assets (ROA)

The return on assets indicates the firm's profitability (Merkley, 2014). Companies which make a profit are more likely to provide a disclosure to signal outsiders that they are profitable (Lim et al, 2007; Meek et al, 1995). However, Lim et al, 2007 did not find evidence that ROA affects the disclosure of R&D strategic information. To calculate ROA I will use the ratio of net income to total assets.

3.3.3 Number of analyst following the company (ANALYST)

Lang et al (1993) in their research paper examine the interaction between the disclosure quality and quantity on the number of analysts which oversee the company. They found out that there is a positive relation between analysts who follow the company and level of disclosure provided by the companies. Consequently, when more analysts follow the company the disclosure level will increase. However, firms which have a large number of analysts patent less (He et al, 2013).

3.3.4 Leverage (LEVERAGE)

Another control variable which I included in my thesis is leverage. Those companies, which issue debt must carry more costs which are associated with the conflict between agent and principle (Meek et al, 1995). In situations when the debt level is high, it affects in a negative way the debt holders in favor of managers and investors (Nekhili et al, 2012). Thus, providing a voluntary disclosure can minimize the conflict between them. Consequently, the level of leverage is related to the frequency of voluntary disclosure. Companies which have high

leverage are more likely to disclose more company-related information (Meek et al, 1995). Ali et al. (2014) presented that financial leverage is related with the level of proprietary cost and those industries in which the level of financial leverage is high will face lower proprietary cost. To measure the leverage, I will follow the technique provided by Ho et al, (2001). They measured leverage by using the proportion of two variables namely total debt and equity for a given company (Ho et al, 2001).

3.3.5 Ownership structure (OWNER%)

There is mixed evidence about the firms in which ownership is dispersed. This is because ownership structure depends on the level of the shares possessed by the shareholders (Ho et al, 2001) and the incentives which motivate shareholders to disclose (Lang et al, 2014). For instance, foreign investors affect the level of disclosure in a positive way because they encourage managers to provide more voluntary disclosures. Additionally, R&D capitalization and R&D intensity have a beneficial effect on managers' choice of providing a voluntary disclosure about the R&D investments (Nekhili et al, 2012). However, in situations when more insiders possess the shares, the company can provide less disclosure to the outsiders (Ho et al, 2001).

3.4 Regression model

The main purpose of my thesis is to examine the relation between the proprietary cost which is measured by the number of patents and the level of the voluntary disclosure in high and low R&D intensive industries. The proprietary cost will be measured following the approach of Jones (2007) where she measures the proprietary cost in R&D intensive firms according to the number of the patents provided by the company. To test the hypothesis, I will provide the following regression model:

$$\text{Disclosure} = \beta_0 + \beta_1 * \text{R\&D intensity} + \beta_2 * \text{number of patents} + \beta_3 * \text{R\&D intensity} * \text{number of patents} + \text{Control Variables}$$

I expect coefficient β_1 to be lower than 0 because R&D intensity is negatively related with the level of voluntary disclosure provided by the companies. One reason for that is that high R&D intensive firms have proprietary information which competitors can use for their own advantage thus they will less likely provide voluntary disclosure to outsiders. Other research also indicates that high R&D intensive firms provide less frequent voluntary disclosure than low R&D intensive firms. This is because for R&D intensive firms competitive position is crucial and those kind of firms face high proprietary cost when they disclose private information. On the other hand, low R&D intensive firms provide more voluntary disclosure because they have lower level of the competition and providing voluntary disclosure does not threaten their position in the market.

Coefficient β_2 should be lower than 0 because the number of patent applications is negatively related with the frequency of voluntary disclosure. Firms which have more patents are less likely to disclose their private information about the company. This is because in patents there are not only information about the patents but also other company related information which can have a negative impact on the future performance of the company. Thus, patents can protect the companies but also provide information which can benefit others.

Coefficient β_3 is higher than 0 because higher number of patents is able to diminish the relation between the level of R&D intensity and the disclosure. Introducing patents not only benefit the competitors by disclosing information about the product but also can give companies form of protection and prevent competitors for using the product or technology. Consequently, firms which have more patents and are R&D intensive can increase their frequency of providing a voluntary disclosure.

4 Results

4.1 Descriptive Statistics

Table 1 displays the descriptive statistics which summarize the main characteristics of the collected dataset. The table presents the mean, standard deviation, median, the first and third quartiles, skewness and kurtosis. The total sample contains 432 unique firms with 3 498 observations over 2010-2019. The collected data is the annual management earnings forecasts.

The mean of management's earnings forecasts is 9.32 and the median is 7.012 which indicate that the distribution is skewed to the right side. The number of patents varies from 0 to 141 with the mean of 17.69. This indicates that my sample contains companies which filed a wide range of patents. The mean and median values of firm size are 7.33, 7.17 respectively and this indicates that my sample contains a lot of large firms. Mean and median value of return on assets amount to 1.1% and 2.1% and that low numbers may indicate that companies may not successfully use their assets. The next variable is the number of analysts following the company with the mean of 9.30 and this implies that the average firm is followed by around 9 analysts. The mean and standard deviation of leverage is 45% and 39% what implies that my sample contains a quite large number of companies which are financed with debt. The average value of institutional ownership amount to 39%.

Table 1 also depicts skewness and kurtosis of variables which were used to perform a regression. Skewness and kurtosis are important to examine because extremely high values may suggest the presence of measurement error and this can lead to wrong results. Appendix 1.3 presents the variables before winsorization. The optimal values for skewness should take values from -3 and 3 and for kurtosis should amount to between -10 and 10. In the table 1 we can see that for variables size and return on assets the skewness is negative which indicates that the distribution is skewed to the left side. For remaining variables skewness is positive which present that the tail of the distribution is longer on the right side. Appendix 1.3 provides that skewness is higher than the optimal level for patents and R&D intensity, thus I winsorize this variable at 5% and 95%. We can see that for patents, R&D intensity and ROA winsorization have a positive impact. For the rest of the variables the skewness and kurtosis stay on the same level thus I include these variables in table 1 as before winsorization.

Table 1 Descriptive statistics of data after winsorization

Variables	N	Mean	Median	Std dev	Min	Max	Q1	Q3	Skewness	Kurtosis
FREQ	3,948	9.323	7.012	10.1	0.00	42.00	5.00	16.00	1.632	4.164
W_R&D INTENSITY	3,948	0.047	0.032	0.012	0.003	0.196	0.01	0.1	1.679	1.893
W_PATENTS	3,948	17.685	0.00	37.005	0.00	141.00	0.00	12.00	2.572	5.513
SIZE	3,948	7.331	7.126	2.136	1.567	12.566	5.8	8.6	-0.070	-0.271
W_ROA	3,948	0.011	0.021	0.1	-0.205	0.156	0.00	0.04	-1.696	2.762
ANALYSTS	3,948	9.30	6.00	9.22	0.00	53.00	2.00	14.00	1.231	1.262
LEVERAGE	3,948	0.454	0.326	0.389	0.00	0.999	0.11	0.63	0.422	-0.923
OWNER %	3,948	0.389	0.178	0.442	0.00	1.00	0.003	0.5	1.323	0.927

Table 1 provides the descriptive statistics for the variables used in regression. FREQ is the number of management forecasts provided by the company in 2010-2019. W_R&D INTENSITY is the R&D intensity and it is winsorized at 5% and 95% level. W_PATENTS is the number of patent applications disclosed by the firms and this variable is winsorized at 5% and 95% level. Five other variables are control variables. First control variable is a firm size (SIZE) calculated by the natural logarithm of total assets. Next control variable is the return on assets (ROA) calculated by the ratio of net income divided by the total assets. This variable is winsorized at 1% and 99% level. ANALYSTS is the variable which describes the number of analysts following the company. LEVERAGE is calculated by the ratio of total debt and equity. The last control variable OWNER is the percentage of institutional ownership in a given year.

4.2 Pearson correlations

Table 2 presents the result of the Pearson correlations. Pearson correlation helps to test the linear relationship between the variables. The independent variable is frequency of the disclosure which is measured by management earnings forecasts. The dependent variable is the number of patents application and control variables are, namely, size of the firm, return on assets, number of analysts following the company, leverage and percentage of institutional ownership.

In line with table 3 there is a significant negative correlation of -0.12 between the frequency of disclosure (FREQ) and R&D intensity. I can also observe that there is a significant correlation of 0.19 between frequency of disclosure (FREQ) and return on assets (ROA). Also, there is a significant correlation of 0.04 between frequency of the disclosure (FREQ) and number of patents (PATENTS). Thus, I can conclude that firms which have more patents disclose more and this is not in line with hypothesis number one which states that firms which have less patents provide more voluntary disclosures. A significant correlation of 0.31 is also observable between frequency of the disclosure (FREQ) and firm size (SIZE) which indicate that larger firms disclose more. There is also a significant correlation between number of analysts which are following the company (ANALYST), leverage (LEVERAGE) and percentage of institutional ownership (%OWNER) which show that firms which have more analysts and greater percentage of institutional ownership provide more voluntary disclosure to the public.

Additionally, I perform variance inflation factor test (VIF). This test provides that the most desirable values of VIF amount to 1 and this indicates that collinearity is not present. The rule of thumb states that collinearity is present when the values are higher than 10. Table 3 presents the Variance Inflation Factor Analysis. In this table we can notice that variables are not higher than 10 and we can see that multicollinearity is not a problem in a collected dataset.

Table 2 Correlation matrix

	FREQ	R&D	PATENTS	SIZE	ROA	ANALYSTS	LEVERAGE	OWNER%
FREQ	1.00							
R&D	-0.12***	1.00						
PATENTS	0.04**	-0.01	1.00					
SIZE	0.31***	-0.18***	0.33***	1.00				
ROA	0.19***	-0.46***	0.10***	0.40***	1.00			
ANALYSTS	0.27***	-0.03***	0.34***	0.55***	0.21***	1.00		
LEVERAGE	0.18***	-0.11***	0.05**	0.38***	0.05**	0.09***	1.00	
OWNER%	0.10***	-0.06***	0.02	0.08***	0.09***	0.07***	0.06***	1.00

Table 2 presents the Pearson correlation table.

***, **, * stars indicate the statistical significance at 1%, 5% and 10% level.

Table 3 Variance Inflation Factor Test

Variables	VIF
R&D	1.309
PATENTS	4.211
R&D *PATENTS	4.021
SIZE	2.060
ROA	1.511
ANALYSTS	1.538
LEVERAGE	1.240
OWNER%	1.015

Table 3 provides the VIF test of the collected variables. VIF helps to test if the multicollinearity is present in the regression.

4.3 Regression analysis

Table 4 provides the regression analysis which main purpose is to examine how patents impact voluntary disclosure in R&D intensive firms. This table provides the main results of the regression which test hypothesis 1, 2 and 3.

First coefficient of interest is the R&D which indicates the level of R&D intensity. This coefficient is negative and significant at the 5% level and amounts to -0.884 with a p-value of 0.026. This is in line with my expectations that the level of R&D intensity has a negative impact on the frequency of voluntary disclosure provided by the companies. One reason for that is the presence of proprietary cost. In line with prior research, R&D intensity is negatively related with the frequency of disclosure. According to Jones (2007), Verrecchia (1983) for some firms, voluntary disclosure can have a negative impact because it can harm their competitive advantage in the market. Especially R&D intensive firms which competitive position play a crucial role and have high proprietary cost provide less disclosure. This coefficient confirms the second hypothesis which states that high R&D intensive companies provide less voluntary disclosure to the public.

Second coefficient is related to the first hypothesis which states that the number of patents have a negative impact on the level of voluntary disclosure. Firms are using patents to protect themselves from competitors. Simultaneously large number of patent applications indicates that firms have a high level of proprietary information. This provides that a high

number of patents leads to less disclosure. Table 4 presents that the coefficient (PATENTS) is negative and significant at 1% level and amounts to -0.003 with a p-value of 0.06. This is in line with my expectations and confirms my first hypothesis. Prior research indicates that companies which have high proprietary cost provide less disclosure because of the competitive position in the market (Jones, 2009). Correlation in table 2 presents that the relation between frequency of the disclosure and patents is positive, however in regression the relation between number of the disclosure and patents is negative. One reason of the different sign of these variables may suggest random variation around zero. This is because the original relationship between frequency of the disclosure and patents is close to zero.

Hypothesis 3 examines whether the negative relation between R&D intensity and disclosure can be diminished by the number of patents. Variable R&D*PATENTS test this hypothesis. The coefficient and p-value amount to -0.01 and 0.898 respectively. We can see that this coefficient is negative but not significant. Thus, I cannot accept or reject the 3 hypotheses. Important is to provide another test which will examine this hypothesis.

In regression I also include five control variables. All of them are statistically significant at 1% level. First control variable is size of the firm and there is a positive relation between firm size and frequency of voluntary disclosure meaning that for each unit increase in a firm size the level of disclosure increases by 0.603. This indicates that larger firms provide more voluntary disclosure to the outsiders. This is consistent with prior research provided by (Lim et al, 2007) which present that larger firms disclose more private information than smaller firms. One reason of that is that larger firms have more investors who require more information about the company performance. The number of analysts is also positive and significant which indicates that firms which have more analysts provide more disclosure. This is consistent with prior studies provided by Lang et al (1993) which conclude that the number of analysts is positively related with the frequency of the disclosure. Another control variable used in regression is ROA which is positive and significant. I can interpret that for one unit increase in ROA the frequency of voluntary disclosure increases by 0.440. Percentage of institutional ownership is also positive and significant and this indicates that those firms which have higher percentage of institutional ownership provide more frequent disclosure. The regression has 3498 observations with an R square of 0.137. This demonstrates that 13.7% of variation in the frequency of disclosures is explained by the independent and control variables included in a model.

Table 4 Regression including frequency of voluntary disclosure as dependent variable

	Coefficient	Standard error	t-statistic	p-value
(Intercept)	0.175	0.503	0.347	0.729
R&D	-0.884	0.397	-2.226	0.026**
PATENTS	-0.003	0.011	-2.761	0.006***
R&D*PATENTS	-0.001	0.009	-0.128	0.898
SIZE	0.603	0.083	7.703	0.000***
ROA	0.440	1.647	3.302	0.000***
ANALYSTS	0.155	0.017	9.372	0.001***
LEVERAGE	2.474	0.462	5.357	0.000***
OWNER%	1.184	0.289	4.100	0.000***
<i>Number of observations</i>	3498			
<i>Adjusted R²</i>	0.1286			
<i>F-statistic</i>	69.24			

Table 4 presents the results of the regression including year fixed effect in year 2010-2019. All variables are defined as per table 1.

***, ** and * presents statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5 provides the results of the regression including year fixed effect. It is important to control year fixed effect because there can be special events such as COVID-19 pandemic or financial crisis in 2008 which may affect the results of the regression.

In my sample in year 2011 the America Invents Act was introduced. This Act provide a couple of changes in patents system. First change was to adjust the system to a “first inventor to file” and give the rights for patents this entity or person which filled the patent application and not as before the creator of the product. This could have a couple of negative consequences such as do not protect small creators or companies and give advantage to the larger firms. This change had also a negative impact on the firm’s competitiveness (Jason, 2012).

Thus, important was to introduce year fixed effect to the regression to see whether time has impact on the level of disclosure across 2010-2019. Table 5 depicts that coefficient is not

significant across years. This indicates that time has no effect on the relationship between the frequency of voluntary disclosure and proprietary cost.

Table 5 Regression including year fixed effect

	Coefficient	Standard error	t-statistic	p-value
(Intercept)	-0.207	1.229	-0.169	0.866
R&D	-0.908	0.397	-2.281	0.023**
PATENTS	-0.003	0.011	-2.739	0.006***
R&D*PATENTS	-0.013	0.009	-0.148	0.882
SIZE	0.605	0.083	7.310	0.000***
ROA	5.353	1.649	3.245	0.001***
ANALYSTS	0.156	0.017	9.413	0.000***
LEVERAGE	2.465	0.462	5.330	0.000***
OWNER%	1.170	0.289	4.045	0.000***
<i>Year fixed effect</i>				
2010	0.011	1.025	0.011	0.988
2011	0.050	1.175	0.043	0.966
2012	0.140	1.170	0.119	0.905
2013	0.143	1.165	0.122	0.903
2014	0.409	1.162	0.351	0.725
2015	0.836	1.162	0.719	0.472
2016	0.295	1.162	0.254	0.799
2017	0.702	1.162	0.605	0.546
2018	0.503	1.162	0.433	0.665
2019	0.167	1.170	0.143	0.886
<i>Number of observations</i>	3498			
<i>Adjusted R²</i>	0.1279			
<i>F-statistic</i>	32.82			

Table 5 presents the results of the regression including year fixed effect in year 2010-2019. All variables are defined as per table 1.

***, ** and * presents statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6 presents the distribution of the firms according to the Standard Industry Classification code. The sample consists of 432 firms and it is divided into 11 industries. I can observe that the number of firms vary from 7 to 91. Pharmaceutical industry consists of only 7 firms which poses 7.41% of the whole sample. On the other hand, business industry contains 91 which poses 21.06% of the whole sample. In the last column the R&D intensity is provided. R&D intensity amount from 0.02 which indicates that industry is low R&D intensive to 12.91 which presents that industry is high R&D intensive. Firms which have the lowest R&D intensity are food and drink, transportation and materials industry. Whereas the firms which are high R&D intensive are pharmaceutical, electronic, chemicals and retail industry. I calculate R&D intensity using the formula below:

$$\frac{\sum_{i=1}^m Ri}{\sum_{i=1}^n Si}$$

Where:

R- R&D expenditure,

S- sales,

i - represent firm,

Table 6 Classification of the firms according to the SIC code

Type of the industry	Number of firms	Percentage of the firm	R&D intensity
Chemicals	56	13%	3.05
Electronics	47	10.85%	9.65
Food and drink	32	7.41%	0.02
Pharmaceutical	7	1.62%	12.91
Industrial	85	19.68%	2.05
Materials	49	11.34%	0.08
Mineral extraction	10	2.31%	0.09
Business	91	21.06%	1.30
Retail	25	5.78%	3.20
Transportation	19	4.4%	0.06
Wholesale	11	2.55%	1.95
Totals:	432	100%	

Table 7 Regression analysis including industry fixed effect

	Coefficient	Standard error	t-statistic	p-value
(Intercept)	0.543	0.542	1.002	0.316
R&D	-0.955	0.396	-2.409	0.016**
PATENTS	-0.003	0.001	-2.658	0.008***
R&D*PATENTS	0.000	0.009	0.013	0.990
SIZE	0.581	0.083	7.022	0.000***
ROA	5.548	1.646	3.374	0.001***
ANALYSTS	0.156	0.016	9.473	0.020**
LEVERAGE	2.606	0.461	5.649	0.000***
OWNER%	1.168	0.288	4.058	0.000***
<i>Industry fixed effect</i>				
Chemicals	-0.344	0.418	-0.825	0.410
Electronics	-0.140	0.434	-0.323	0.746
Food and drink	-0.055	0.526	-0.105	0.917
Materials	-2.126	0.969	-2.194	0.028**
Industrial	-0.024	0.371	-0.064	0.949
Pharmaceutical	-1.792	0.466	-3.849	0.000***
Mineral extraction	2.032	0.906	2.243	0.025**
Business	1.943	0.933	2.081	0.037**
Retail	-1.830	0.585	-3.126	0.002***
Transportation	-0.385	0.612	-0.629	0.530
Wholesale	1.542	0.761	2.025	0.043**
<i>Number of observations</i>	3498			
<i>Adjusted R²</i>	0.1449			
<i>F-statistic</i>	32.18			

Table 7 presents the results of the regression including industry fixed effect. All variables are defined as per table 1.

***, ** and * presents statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7 provides regression including industry fixed effect. Contrary to year fixed effect when in regression industry fixed effect is included some industries are significant.

This indicates that the inclusion of industry fixed effects affects significantly the regression. According to the table Pharmaceutical and Retail industry are statistically significant at 1% level. In line with table 6 Pharmaceutical industry has the highest R&D intensity. The coefficient of this variable is negative which I can interpret that high R&D intensive firms provide less frequent voluntary disclosure to the public. In regression there are also four variables which are statistically significant at 5% level. Those industries are Mineral extraction, Business, Wholesale and Materials industry. Thus, we can observe that R&D intensity have impact on the frequency of the voluntary disclosure. To conclude, I can observe that six out of eleven industries is statistically significant, suggesting variation in voluntary disclosure levels across industries. The R squared is equal 14.49 and it is higher than in regression provided in table 4. Including industry fixed effect hypothesis 1 and 2 is confirmed. This indicate that number of management earnings forecasts is affected by industry fixed effect.

Table 8 Regression including the disclosure as a dummy variable

	Coefficient	Standard error	t-statistic	p-value
(Intercept)	0.234	0.320	7.303	0.000***
R&D	-0.104	0.253	-4110	0.000***
PATENTS	-0.000	-0.000	-3.632	0.003***
R&D*PATENTS	0.000	0.000	0.864	0.388
SIZE	0.040	0.005	7.540	0.000***
ROA	0.297	0.105	2.837	0.005***
ANALYSTS	0.008	0.001	7.887	0.000***
LEVERAGE	0.141	0.029	4.797	0.000***
OWNER%	0.092	0.018	5.000	0.000***
<i>Number of observations</i>	3498			
<i>Adjusted R²</i>	0.1286			
<i>F-statistic</i>	65.51			

Table 8 presents the results of the regression including industry fixed effect. All variables are defined as per table 1.

***. ** and * presents statistical significance at the 1%. 5% and 10% levels, respectively.

Table 8 presents the results of logit regression using the frequency of a voluntary disclosure as a binomial dummy variable. In this regression frequency of the disclosure is a dummy variable which takes values 0 or 1. Value of 0 have firms which did not provide a voluntary disclosure to the outsiders in a given year whereas value of 1 have firms which present their private information through disclosure. According to table 8 I can observe that variable R&D become more significant. In the table 4 its significance was at 5% however in this regression it is significant at 1% level. Thus, this regression confirms hypothesis 1 and 2 which states that number of patents and R&D intensity have impact on the disclosure. However, I cannot reject or confirm the third hypothesis which test interaction between number of patents and R&D intensity on the disclosure because p-value of R&D intensity*patents is insignificant. The R square for this regression amount to 12.86 and is in the same level as regression in table 4 and has a lower value than regression including year and industry fixed effect.

5 Conclusions

This thesis examines the association between proprietary cost and frequency of voluntary disclosure. Proprietary cost is measure using the number of patents while the frequency of the disclosure using the number of management forecast. In my paper I also focus to examining if and how R&D intensity impacts the level of disclosure. To capture the frequency of voluntary disclosure I include control variables such as firm size, return on assets, number of analysts following the company, leverage and percentage of ownership structure. Prior research papers provides that proprietary cost has a negative impact on the amount of the voluntary disclosure provided by the companies.

First, I examine how proprietary cost have an impact on the level of voluntary disclosure. My evidence is consistent with prior research provided by (Dye 1983; Jones 2007; Verrecchia 1983) which presents that firms which have high proprietary cost disclose less voluntarily. Using number of patents as a measure of proprietary cost I conclude that companies which provide more patents must deal with higher proprietary cost and consequently disclose less. This is because for firms with higher proprietary cost voluntary disclosure has a negative impact on their competitive position in the market. Next, the relation between R&D intensity

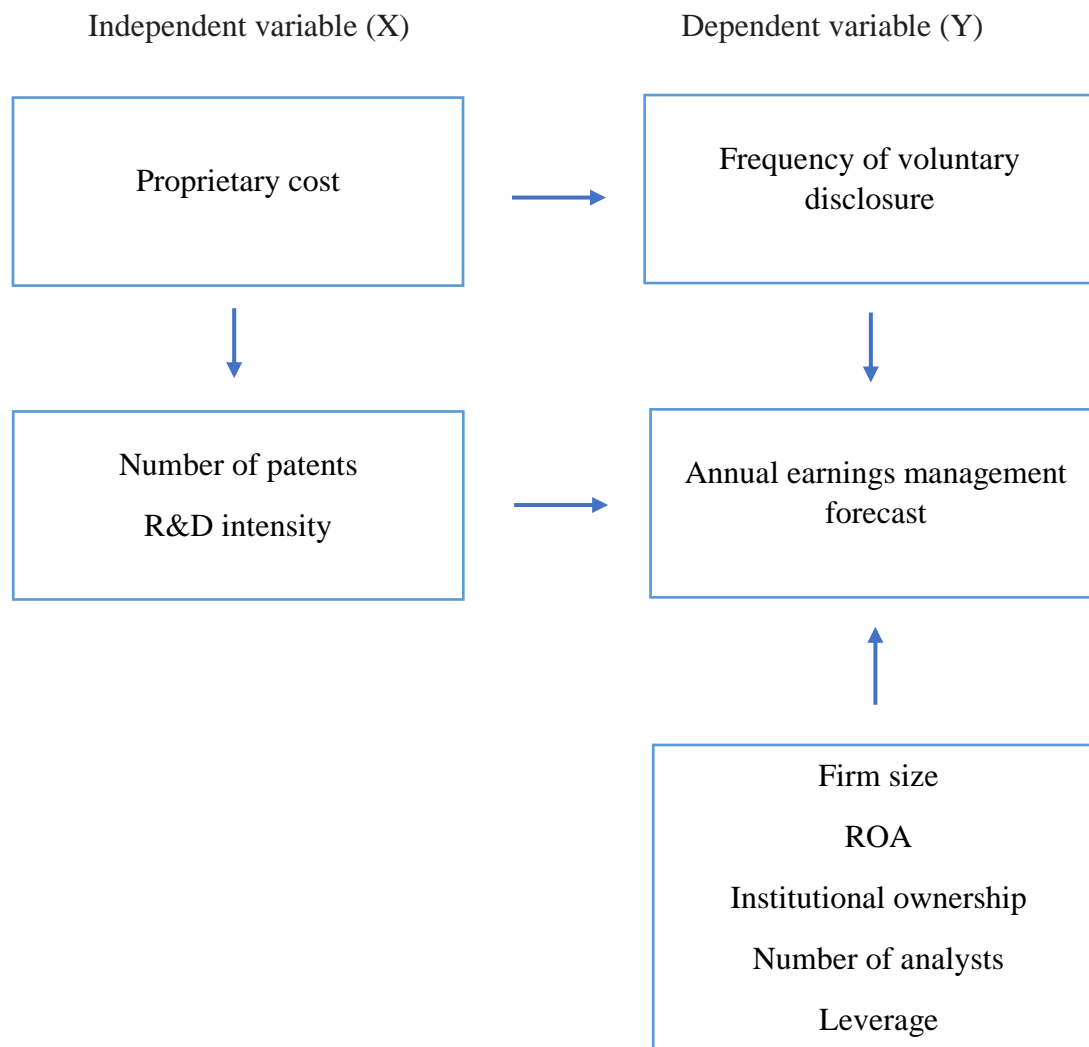
and the frequency of voluntary disclosure is examined. I find a significant result which supports my claim that R&D intensity and frequency of the disclosure are negatively related. Voluntary disclosures are beneficial for the companies because they reduce the information asymmetry between company and participants. However, in line with my studies high R&D intensive firms still prefer a greater discretion to protect from their rivals which can use the disclosure to gain a competitive advantage. This indicates that companies which provide more patents have high proprietary cost and they disclose less because the disclosure have a negative impact on their competitive position in the market. Lastly, I analyze whether number of patents can diminish the negative relation between R&D intensity and frequency of the disclosure. I find no evidence which support this hypothesis. This may be due to the fact that in my thesis I focus on the US firms and as far as know my thesis is the first study which examines this relation.

My thesis contains some limitations. First limitation is that sample include only US based firms. In that reason external validity can suffer because studies cannot be applicable across different countries such as the Netherlands or Germany. For instance, in the USA America Invents Act was introduced which provides the changes in the U.S. patent system and this act is not present in European countries. Another limitation is that distribution of the observation is different across analyzed years. I include the observations from 2010-2019 and in appendix it is present that this sample is not evenly distributed. The sample differs from 49 in year 2010 to 412 in year 2016. The next limitation is that I include five control variables to decrease omitted variable problem. However, even if the control variables are included there is still possible that endogeneity can be present and have an impact on the results.

Further research can examine how proprietary cost have an impact on the frequency of voluntary disclosure in another countries. Also, in my thesis I focus on the annual management earnings forecasts but it will be interesting to see analysis on quarterly management earnings forecasts.

6 Appendix

Appendix 6.1 Libby boxes



Appendix 6.2 List of variables

Variables	Variable measurement	Reference	Predicting effect on the frequency of the disclosure
Independent variable			
Forecast frequency	It is calculated using the annual number of annual management earnings forecasts.		
Dependent variable			
Proprietary cost	Number of patents provided by the companies annually.	Jones (2007)	-
Control variables			
Firm size	Calculated as logarithm of total assets.	Lim et al (2007)	+
Return on assets	Calculated as ratio of net income to total assets.	Meek et al 1995) Lim et al (2007)	+/-
Number of analysts	Number of analysts following the company in a current year.	Lang et al (1993)	+
Institutional ownership	Calculated as percentage of institutional ownership in a current year.	Nekhili et al (2012) Ho et al (2001)	+/-
Leverage	Calculated as ratio of total debts to equity.	Ali et al (2014) Ho et al (2001)	+

Appendix 6.3 Descriptive statistics before data winsorization

Variables	N	Mean	Std dev	Min	Max	Q1	Q3	Skewness	Kurtosis
FREQ	3,948	4.000	7.523	0.00	42.00	0.00	12.00	1.300	2.227
R&D INTENSITY	3,948	0.034	46.540	0.003	0.196	0.006	0.137	58.257	3426.22
PATENTS	3,948	12.485	217.496	0.00	141.00	0.00	17.00	9.742	112.874
SIZE	3,948	7.126	2.057	1.567	12.566	5.711	8.436	0.014	-0.201
ROA	3,948	0.021	0.088	-0.205	0.156	-0.005	0.043	-2.668	12.175
ANALYSTS	3,948	6.000	8.887	0.00	53.00	2.00	13.00	1.359	1.711
LEVERAGE	3,948	0.326	0.285	0.00	0.999	0.113	0.594	0.436	-0.961
OWNER %	3,948	0.413	0.413	0.00	1.00	0.000	0.529	1.371	1.051

Appendix 6.4 Number of firms per year

Year	Number of firms	Percentage of the firm
2010	40	1.14%
2011	325	9.29%
2012	354	10.12%
2013	385	11.01%
2014	402	11.49%
2015	406	11.61%
2016	412	11.78%
2017	411	11.75%
2018	410	11.72%
2019	353	10.09%
Totals:	3498	100%

References

- Ajinkya, B., Bhoraj, S., and Sengupta, P. (2005) The association between outside directors, institutional investors and the properties of management earnings forecasts. *Journal of Accounting Research* 43 (3), 343-376.
- Ali, A., Klasa, S., Yeung, E., (2014). Industry concentration and corporate disclosure policy. *Journal of Accounting and Economics*, Volume 58, 240-264.
- Anton, J. J., & Yao, D. A. (2004). Little patents and big secrets: managing intellectual property. *RAND Journal of Economics*, 1-22.
- Akhtaruddin, M. (2005) Corporate mandatory disclosure practices in Bangladesh. *The International Journal of Accounting* 40, 399 – 422.
- Baruch, L., Penman, S.H. (1990). Voluntary Forecast Disclosure, Nondisclosure, and Stock Prices. *Journal of Accounting Research*, Vol. 28, No. 1, 49-76.
- Berger, P., Hann, R., (2007). Segment profitability and the proprietary and agency costs of disclosures. *The Accounting Review* 82, 869–902.
- Beyer, A., Beverly, R.W., Cohen, D, A., Lys, T. Z., (2010). The financial reporting environment: Review of the recent literature. *Journal of Accounting and Economics* 50, 296-343.
- Bound, J., Cummins, C., Griliches, Z., Hall, B. H. and Jaffe, A. (1984). Who does R&D and who patents, in R&D, Patents and Productivity. University of Chicago Press, Chicago, pp. 21-54.
- Buzby L.S., (1975). Company Size, Listed Versus Unlisted Stocks, and the Extent of Financial Disclosure. *Journal of Accounting Research*, Vol. 13, No. 1, 16-37.
- Cheyne, E., (2012). A theory of voluntary disclosure and cost of capital, *Review of Accounting Studies* 18, 987–1020.
- Campbell J.L., (2021). The effect of mandatory disclosure on market inefficiencies: Evidence from FASB Statement No. 161. *The accounting review*, Vol 96, No. 2, 153-176.

Darrrough, M. and Stoughton, N. (1990). Financial disclosure policy in an entry game, *Journal of Accounting and Economics* 12, 219-244.

Dedman, E., Lin, S.W., Prakash, A.J., Chang, Ch., (2008). Voluntary disclosure and its impact on share prices: Evidence from the UK biotechnology sector. *Journal of Accounting and Public Policy* 27. 195-216.

Diamond, D.W., and Verrecchia R. E. (1991). Disclosure, Liquidity, and the Cost of Capital. *The Journal of Finance*. Vol. 46, No. 4, 1325-1359.

Ding, Y., G. Entwistle, and H. Stolowy, 2004, "Differences in R&D Disclosure Practices: Evidence in a French and Canadian context," *Advances in International Accounting*, 17, 55-72.

Dye, R.A., (1986). Proprietary and Nonproprietary Disclosures. *The Journal of Business* 59, No. 2, 331- 366.

Dye, R.A., and Sunder S., (2001). An evaluation of Essays on Disclosure and the disclosure literature in accounting. *Journal of Accounting and Economics*, 32 (1-3), 181-235.

Einhorn, E. (2005). The nature of the interaction between mandatory and voluntary disclosures. *Journal of Accounting Research*, 43(4), 593–621.

Ethiraj, S. K., & Zhu, D. H. (2008). Performance effects of imitative entry. *Strategic Management Journal*, 29, 797-817.

Fishman, M.J., and Hagerty K.M., (2003). Mandatory versus voluntary disclosure in markets with informed and uninformed customers. *Journal of Law Economics and Organization* 19, No.1 45-63.

Francis, J., Nanda, D., and Olsson, P., (2008). Voluntary disclosure, earnings quality, and cost of capital. *Journal of Accounting Research* 46, 54–99.

Graham, J.R., Harveya, C.R., and Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40, 3–73.

Gu, L., (2016). Product Market Competition, R&D Investment and Stock Returns. *Journal of Financial Economics* 119, 441-455.

Guo, R., Lev, B., Zhou, N., (2005). The Valuation of Biotech IPOs. *Journal of Accounting, Auditing and Finance*, 423-459.

Gunawan, H., and Lina, E. O., (2015). Mandatory and Voluntary Disclosure of Annual Report on Investor Reaction Hendra Gunawan, *International Journal of Economics and Financial Issues* 5, 311-314.

Harabi, N. (1995). Appropriability of technical innovations and empirical analysis. *Research Policy*, 24(6), 981-992.

Harris, M.H., (1998). The association between competition and managers' business segments reporting decisions, *Journal of Accounting Research* 36, 111-128.

He, J.J., Marlene, A., and Wen, P.H., (2019) Voluntary disclosure, mandatory disclosure and the cost of capital. *Journal of Business Finance & Accounting* 46, 307–335.

He, J.J., Tian, X., (2013). The dark side of analyst coverage: The case of innovation, *Journal of Financial Economics* 109, 856-878.

Healy, P. M., Hutton, A. P., & Palepu, K. G., (1999). Stock performance and intermediation changes surrounding sustained increases in disclosure. *Contemporary Accounting Research*, 485-520.

Kothari, S.P., Laguerre, T.E., & Leone, A.J., (2002). Capitalization versus expensing: Evidence on the uncertainty of future earnings from capital expenditures versus R&D outlays. *Review of Accounting Studies*, 7(4), 355–382.

La Rosa, F., and Liberatore G., (2014). Biopharmaceutical and chemical firms R&D disclosure, and cost of equity: The impact of the regulatory regime. *European Management Journal* 32. 806-820.

Lang, M., Lundholm J.R., (1996). Corporate disclosure policy and analyst behaviour, *The Accounting Review*, Vol. 71, No. 4. 467-492.

Lang, M., Sul, E., (2014). Linking industry concentration to proprietary costs and disclosure: Challenges and opportunities, *Journal of Accounting and Economics* 56. 265-274.

Li, X., (2010). The impacts of product market competition on the quantity and quality of voluntary disclosures. *Review of Accounting Standards* 15, 663–671.

Lim, S., Matolcsy, Z., and Cho, D., (2007). The association between the board composition and different types of voluntary disclosure. *European Accounting Review*, 16 (3) 555-583.

Luo, S. M., and Courtenay M. S., (2006). The effect of voluntary disclosure, ownership structure and proprietary cost on the return–future earnings relation. *Journal of finance* 14, 501–521.

Makar, S.D., Alam, P., and Pearson M.A., (1996). Earnings management : the case of political costs over business cycles. *Business and Professional Ethics Journal*, 15 (2), 33-50.

Meek, G.K., Roberts, B.C., Gray, S.J., (1995). Factors Influencing Voluntary Annual Report Disclosures by U.S., U.K. and Continental European Multinational Corporations, *Journal of International Business Studies*, Vol. 26, No. 3, 555-572.

Merkley, K.J., (2014). Narrative disclosure and earnings performance: Evidence from R&D disclosures. *The Accounting Review*, 89 (2), 725-757.

Percy, M., (2000). Financial reporting discretion and voluntary disclosure: Corporate research and development expenditure in Australia, *Asia-Pacific Journal of Accounting and Economics* 7. 1-31.

Polidoro Jr., F., & Theeke, M. (2012). Getting competition down to a science: the effects of technological competition on firms' scientific publications. *Organization Science*, 23(4), 1135-1153.

Pownall, G., Waymire, G., (1989). Voluntary disclosure choice and earnings information transfer. *Journal of Accounting Research* 27. 85-105.

Raith, M., (2003). Competition, Risk, and Managerial Incentives. *The American Economic Review* 93. 1425- 1436.

Scott, T.W., (1994). Incentives and disincentives for financial disclosure: voluntary disclosure of defined benefit pension plan information by Canadian Firms. *The Accounting Review*. Vol. 69 No.1, 26-43.

Sehata. N.F., (2014). Theories and Determinants of Voluntary Disclosure. *Accounting and Finance Research* 3, 18-26.

Skinner, D.J., (1994). Why Firms Voluntarily Disclose Bad News. *Journal of Accounting Research*, Vol. 32, No. 1, 38-60.

James D.S., (2014) Use of Voluntary Public Disclosure and Patent Strategies to Capture Value from Product Innovation, *Journal of Applied Business and Economics* vol. 16(5), 11-26.

Trueman, B.,(1985). Why do managers voluntarily release earnings forecasts? *Journal of Accounting and Economics* 8. 53-71.

Verrecchia, R.E., (1990). Endogenous proprietary costs through firm interdependence. *Journal of Accounting and Economics* 12, 245-250.

Verrecchia, R.E., (2001). Essays in disclosure. *Journal of Accounting and Economics* 32, 97–180.

Watts, R., and Zimmerman, J., (1983). Agency Problem, Auditing and Theory of the Firm: Some Evidence, *Journal of Law and Economics*, 12 (26), 613-633.