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CEO Ownership and Innovation Investments: *Is Shareholding Incentivizing Enough?*

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Abstract

Agency theory suggests that managers may under- or over-invest in R&D depending on whether they see the risks or possibilities investing in it. This study examines how CEO ownership is related to investments made in R&D. This is done by maintaining two different regression analyses where one investigates how CEO ownership affects investments in R&D on a broader level and the other investigates different ownership levels and how the different levels relate to the investment behavior. For the study, Swedish firms listed on OMX (Large, Mid & Small-Cap) and First North have been studied between 2017 and 2020. It is significantly found that CEO ownership is positively related to investments made in R&D, something which is in line with the first hypothesis. This suggests that ownership in the firm is likely to abate the under-investment problem. However, segmenting for different ownership levels, significant results are only identified at lower/medium CEO ownership levels, hence not making it possible to draw any conclusions about how CEO ownership relates to the investment behavior at higher ownership levels.

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1. Introduction

1.1 Background

1.1.1 Introduction to the Topic of Innovation

This study aims to look closer at how CEO ownership affects investments made in innovation, measured by looking at expenditures in research and development (hereby R&D). Investing time and money in innovation has for long been considered a central driver for future growth (Solow, 1957). Investing in innovation is an essential part of developing and being up to date with new technologies and services. Without investing money in R&D the likelihood of delivering outdated products or services becomes higher. In general investments in R&D help strengthen existing and new market positions which is vital to maintain competitive and have a high performance (He and Wong, 2004; Katila and Ahuja, 2002).

Soferman (2020) states that it is important to focus on R&D spending, both in good and bad times. They argue that it is likely to not invest in R&D during a recession but emphasize doing so as it signals confidence in the company. This, as the creation of new and more efficient products in times of crisis, can help companies from a decline and help them out of a negative trend. Fernandez et al. (2018) further take a more up-to-date stand on the topic and elaborates on the importance of innovation in terms of sustainable growth. In recent times the attitude towards sustainability has become critical for all economies in the world. From the study, it is found that higher expenditures on R&D help decrease total CO2 emissions, which thereby helps in the striving toward more sustainable development.

What differentiates R&D expenditures from most other expenditures is that their outcomes are uncertain in terms of timing and existence. The high uncertainty makes it difficult for shareholders to predict their value, yet they are still essential for the existence and development of firms. The high underlying uncertainty makes it valuable to study their holding periods (Lee & O'Neill, 2003). Froot et al. (1991) suggest that shareholders having a shorter holding period, tend to cause managers to also have a shorter holding period, which in turn causes them to avoid investments in R&D completely. In addition to this, Stein (1988,1989), suggests that the short-term behavior is a consequence of shareholders being profit-conscious, causing the managers to avoid long-term investments in R&D.

1.1.2 Corporate Governance

Looking at most companies worldwide, few are managed purely by their owners. Rather than involving shareholders in all decision-making, certain tasks are delegated to different managerial actors, which helps create efficiency in the daily operations. However, this division causes the "principal-agent" issue to arise (Berk & DeMarzo, 2017). The principal-agent issue suggests that the interest of shareholders and managers are often in contrast with one another and that a firm that is 100% owner-led is often more efficient in comparison to a firm that is not 100% owner-led. This as the maximization of profits also leads to the maximization of their own utility. In firms that are not 100% owner-led on the contrary, managers are likely to want to maximize their own utility which might go into conflict with the maximization of the firm's profits (Jensen & Meckling, 1976). For example, Shleifer and Vishny (1997) suggest that upper managers can be affected by other aspects in a company than firm profits, such as remuneration, wealth interests, or working conditions, causing them to act in their own self-interests, rather than aligning with the shareholders.

1.1.3 Firm Innovation and Managerial Incentives

Despite investments in innovation having a potentially high reward, these are often long-term and uncertain, which causes many managers to be less willing to invest in innovative investments. Therefore, the structure of a firm's management is a key driver of how much is invested in innovation. This as, failing this kind of investment can have a negative impact on a mangers' career and affect their remuneration negatively. To invest in R&D managers need to have a high tolerance for failure as it is otherwise likely to result in an *under-investment* of R&D (Holmström, 1989).

In addition to the *under-investment* argument, stands the *over-investment* argument suggesting the opposite relationship. Baker et al. (1988) shows that a manager's wage is positively correlated with increasing firm size. They see that by investing more in innovation, it is likely for firms to grow and therefore for a manager's remuneration to increase. This shows that there are two opposing arguments that stand in contrast with each other that are important when studying a manager's decision to invest in R&D.

To mitigate the agency problem and align the interests of shareholders and managers, increasing the ownership stake owned by managers is likely to make these act in line with the

owners. By owning a larger ownership stake managers become incentivized to act more in line with owners (Jensen & Meckling, 1976). However, managers gaining a larger amount of power are also likely to make use of the firm in a way as to maximize their own needs rather than purely acting in the interests of the shareholders. This as ownership is only suggested to be beneficial up to a certain point and that ownership beyond this point is likely to result in managers using the firm to pursue private benefits and not acting in line with shareholders (Shleifer & Vishny, 1997).

1.2 Purpose of the Study

With the above in mind, the purpose of this report is to see whether the level of CEO ownership is a contributing factor to how much is spent on R&D in organizations. CEO ownership is measured by how many shares out of the total number of outstanding shares that are owned by the CEO. The R&D parameter is measured by looking at how large expenditures there are on R&D, reported in the income statement for each respective company and year. Berk & DeMarzo (2017) suggest that the CEO is the highest-ranking person, responsible for making important business decisions in combination with maintaining the overall operations. Due to this, it becomes interesting to look at how the level of CEO ownership in a firm affects expenditures made in R&D. The results generated give value to a variety of stakeholders, such as investors and board members, who would like to learn more about how to deal with a principal-agent-related issue that is much relevant today.

1.3 Research Boundaries

In this study the limitation is made to include the total main market OMX Stockholm (Small, Mid & Large cap) in combination with the First North market (Premier & Growth) during the period between 2017-2020. Using companies listed on different exchanges will lead to naturally selecting companies of varying size, which opens for general conclusions about R&D.

1.4 Contribution

This study contributes to the existing literature by being an up-to-date topic that is not well studied before. Previous studies have mainly conducted using full managerial ownership as the independent variable (Beyer et al., 2012; Hassanein et al., 2021). However, this study will solely focus on CEO ownership in line with (Ghosh et al., 2007) who emphasize the CEO's

importance in making investment decisions which makes it interesting to study. Looking at previous studies it can be concluded that nothing similar has been researched on the Swedish market before. The reason for the lack of previous studies might be difficulties in finding relevant data, both on ownership and R&D expenses.

1.5 Disposition

This report is divided into six sections with the second explaining previous literature and theory on the topic, ending with developing hypotheses. Section three explains how the data has been collected and handled, as well as the methodology where the research design is more deeply explained in terms of sample selection, choice of variables, etc. Section four shows the results from the conducted statistical analysis. In section five the results are further analyzed and finally in section six, the conclusions and suggestions for future research are presented.

2. Literature Review and Theory

2.1 Literature Review

The purpose of this section is to describe previous literature and theory written on the topic which aims to lay a foundation for the hypotheses that is examined in the next section. In general, there are three key ideas that are essential for this report and what it aims to study. These are agency issues, the reasons behind investments in innovation and how this varies depending on ownership structure. After explaining these main issues, the hypotheses are developed.

2.1.1 Agency Theory, Control over the Firm and Ownership

Before looking deeper at the relationship between CEO ownership and innovation, this study aims to elaborate on Agency theory. Berle & Means (1932) early studied public firms in America and found that these were often owned by small shareholders with limited possibilities of influencing the corporate governance of the company. The large separation between ownership and control they assumed risk leading to managers maximizing their own utility instead of a company's profits. To solve this, they emphasized transparency, accountability, and voting rights. Jensen and Meckling (1976) further refined Berle and Mean's findings into the clear *Agency theory model*, which more clearly describes the conflict between self-

interested managers who make decisions and owners who take the wealth effects of these choices. By owners (principal) not being able to monitor what managers (agent) do without additional costs, a conflict between the two parties is created. They further elaborate on the effects that ownership has on value creation and suggests that the size of ownership that is devoted to managers and shareholders will cause the principal-agent problem to take different forms. In companies where managers are not owning all equity, the interests are unlikely to be aligned with external shareholders which creates a conflict between the two parties (Jensen & Meckling, 1976).

2.1.2 Value Creation by Investments in R&D

In the article "R&D, firm size and innovation: an empirical analysis", Shefer and Frenkel (2005) it is suggested that *"R&D expenditures are a sine-qua-non for the firm's level of innovation activities"*. They further explain that R&D investments, both in-house and outsourced, are crucial factors for firms to innovate and to create economic growth. On the other hand, Freeman and Soete, (1997) argue that expenditures in R&D is the most important aspect to look at to see how innovative a firm is. This as R&D expenses results in a competitiveness over its competitors which helps create new ideas.

It is found that R&D expenditures are much dependent on firm size and are more common in larger firms. In general, it is harder for smaller and mid-sized firms to invest in R&D, as these firms have a higher degree of capital scarcity, lack of management and lack of adequately trained personnel (Kleinknecht, 1989). Firms belonging to larger groups are also more likely to invest more in R&D, as such firms generally can receive funding easier (Frenkel et al., 2001). Shefer and Frenkel (2005) further argue that firm-industry plays an important role in deciding what companies and how large their investments in R&D are. For example, the high-tech industry branch consists of many startup companies that naturally are small. Despite their size, these firms tend to invest a lot in R&D. From above, it can be concluded that there are various aspects deciding how large the investments are in R&D that are of value to take into consideration.

2.1.3 Ownership Level, R&D Expenditures and Added Risk

As investments in innovation through R&D involves a lot of risk it becomes an important parameter to evaluate when analyzing its relationship with CEO ownership. Francis & Smith

(1995) states that one key aspect in a manager's decision to invest in R&D is the riskiness that the investment involves. In general, they explain that there are three reasons to why innovative investments are likely to result in added risk. First, investing money in R&D is about development of new products and services, which means that the chance of investing in unsuccessful projects is high. Secondly, there is often a significant time lag between the implementation and outcome of a project, causing a long time in generating cash flows. Thirdly, the time it takes to generate cash flows is hard to predict which further adds to the riskiness for the investment (Francis & Smith, 1995).

Due to the risks and high agency costs innovative investments involve, the managerial ownership level plays an important role for investments in innovation. On the one hand, Holmström (1989) argues that the high risks that come with innovative investments cause managers to *under-invest* in such projects. This as failing an investment can potentially have negative consequences on a manager's career and their monetary holdings. On the other hand, Baker et al. (1988), and Murphy, (1985) argue for the opposite and suggest that managers are more likely to *over-invest* in R&D in relation to owners as investing in R&D can lead to company growth and hence private benefits like higher remuneration for the manager.

2.1.4 The Incentive and the Entrenchment Effects

Studying the level of ownership and how this affect firm performance there are two enacting forces that come to play called the *incentive* and *entrenchment effect.* What the *incentive effect* suggest is that an increased managerial ownership level leads to closer alignment with the interests of shareholders, suggesting for managers to act in a value maximizing way for the two parties. On the other hand, the opposing theory, the *entrenchment effect*, suggest that an increasing level of managerial ownership leads to a decreased power to minority shareholders and thereby their influence on decision making. With a larger ownership, managers have a higher job security and bargaining power which makes it possible to make decisions that are not value-maximizing for the shareholders, but rather in the interest of themselves (Schleifer & Vishny 1997; Morck et al., 2005). Morck et al. (1988) have looked deeper into this issue and have found that profitability increases with increasing ownership up to a five-percent level but falls thereafter. The falling profitability and the costs that come with the increasing ownership level they explain by managers being able to use the firm to pursue private benefits and thus the *entrenchment* effect kicks in.

The literature that is written on the *incentive and entrenchment effect* with regards to innovation is not extensive but shows that these effects are important to understand in a manager's decision to invest in R&D. Beyer et al. (2012) have made a deeper study into this by comparing firms that are 100% owner-led with those that are manager-led owning between 0-100% of the firm value. With regards to the principal-agent issue, they suggest that firms that are 100% owner-led invest in R&D at a value-maximizing level, as their investment strategy aims to be profit-maximizing for the owners. Using this R&D level as a point of reference they compare with firms that are manager-led owning equity stakes between 0-100%. They suggest that firms with an increasing managerial ownership stake would converge their investment behavior in R&D to equal that of 100% owner-led firms (*incentive effect*). On the other hand, they argue that R&D expenditure levels that exceed those of 100% owner-led firms, and thus are not value maximizing, rather can be explained by managers pursuing their own interests (*Entrenchment effect),* (Beyer et al., 2012).

From Beyer's study, it is shown that ownership levels affect investments in R&D. R&D investments are positively related to ownership at low levels which is explained by an increasing managerial ownership leading to a closer alignment between managers and shareholders *(incentive effect)*. However, R&D investments continue to increase beyond the level that 100% owner led firms do, indicating that managers with an increasing ownership level tend to invest at higher levels than what is considered value maximizing for the firm value *(entrenchment effect* outweighs *incentive effect).* At approximately 54% level of ownership, they further see that managers tend to decrease their investments in R&D, suggesting that the interests of managers will again converge towards those of 100% owners. This they explain by the *(incentive effect* outweighing *entrenchment effect)* and the manager being too exposed to the firm which results in less risky investments in R&D (Beyer et al., 2012).

2.1.5 Positive Relationship

According to Jensen and Meckling (1976), a total alignment between the interests of managers and shareholders results in managers behaving in a way that benefits shareholders. Aghion et al. (2012) argue that R&D investments are value-creating for the firms, which help explain why managers should be more willing to invest in R&D. Owning a larger stake in the company therefore causes managers to behave more like pure owners as their view about firm maximization is aligned (Shleifer & Vishny, 1997).

Baker et al. (1988) have found that a manager's remuneration and various perquisites are positively correlated with firm size, something which risk leading to *over-investment* in innovation. Aghion et al. (2012) argues that firm innovation is a much relevant tool for firm growth. By focusing on innovative investments through R&D, companies can grow over time which in turn can result in managers to increase their remuneration. To exemplify this, Baker et al. (1988) presents a general rule suggesting that the salary of executives increases by 3% for every 10% increase in firm sales. However, Jensen (1986) states that managers wanting to maximize firm value with the goal of controlling a larger firm, might end up making sub-optimal investments in the eyes of the shareholders. This phenomenon is called *empire-building* and suggests a manager's preference of increased firm size by making large investments, as it leads to personal benefits for them Jensen (1986). As suggested by Beyer et al. (2012) the *entrenchment effect* causes managers to make strategies in their own interests, rather than to maximize firm value. The effect therefore causes managers to *over-invest* in R&D at an increasing ownership level.

2.1.6 Negative Relationship

In contrast to shareholders, it is likely that managers are unwilling to invest in innovation due to the personal risks that come with these kinds of investments. The nature of R&D investments involves a lot of risk that is impossible to get away from (Francis & Smith, 1995). Aghion et al. (2012) argues that failing an investment from a managers' point of view can have large negative impacts on their career with job loss as the worst-case scenario for this. This, Beyer et al. (2012) states risks leading to managers investing in low-risk investments with short-term profits (NPV positive) rather than in an uncertain long horizon investment such as R&D investments. Johnson and Pazderka (1993) also finds this relationship and argue that managers are risk averse and tend to choose short-term investments over long-term investments like R&D. This concept is explained using the *under-investment problem* which elaborates on lower levels of investments in innovation being made because of the high risks and high personal costs it involves (Holmström, 1989).

2.1.7 Non–Linear Relationship

By reading previous studies it can be concluded that there is no definite answer in the relationship between level of CEO ownership and expenditures made in R&D (Ghosh et al., 2007; Hassanein et al., 2021).

Ghosh et al. (2007) studies a sample of US firms and finds that the relationship is different depending on the level of ownership, which is done by segmenting the level of ownership into certain groups. They find that R&D expenditures increase between 0-5% ownership, falls between 5-25% ownership and increase again between 25-100%. In contrast to these results, Hassanein et al., (2021) finds an inverse U-shaped relationship between managerial ownership and R&D spending. This suggests that there is an optimal point of ownership to maximize R&D expenditures, since they risk declining beyond this level. These findings are in line with what Beyer et al. (2012) have found.

2.2 Accounting Regulatory Important for the Study

2.2.1 IFRS and the Implementation of IAS 38

In 2001 the International Accounting Standards Board, IAS 38 *intangible assets* was adopted as a replacement to the previous IAS 9 *Research and development costs*. With the implementation of this regulatory standard, new treatment for intangible assets was introduced. According to the regulation intangible assets are classified as "non-monetary assets", which are assets without physical substance such as licenses, patents, and software. Expenses for intangible items are recognized as expenses unless they can be defined as an intangible asset, by following these following criteria:

1. *It is probable that future economic benefits will flow to the entity from the asset*
2. *The cost of the asset can be reliably measured*

Costs of generating intangible assets internally is hard to measure as they are very uncertain in its nature. With regards to this, IAS 38 makes a further distinguish and divides R&D projects into a ***research phase*** and a ***development phase***. Expenditures made in the research phase are always expensed whereas development expenditures are recognized as an intangible asset only in case certain criteria (six in total) are fulfilled. In cases where it is not possible to identify whether the expense should belong to the research phase or development phase, it should only be reported in the research phase and therefore be expensed as it occurs. Development expenditures that meet the criteria are subject to impairment testing. In case the intangible asset has a finite lifetime, it is also amortized over its useful life (IFRS Foundation, 2021).

2.2.2 Swedish Domestic Accounting Regulatory K3

The First North stock exchange is divided into two segments called First North Growth Market and First North Growth Market Premier. For firms listed on the first, domestic accounting standards, K3 apply, whereas the latter are regulated by international accounting standards, IFRS and thus IAS 38 (Kostyál, 2019). In terms of R&D expenditures both standards have similar approaches to when it is possible to expense and capitalize with one clear distinction. Companies regulated by K3 has a choice to either choose to expense R&D costs immediately "expense model" or to capitalize these "capitalization model". In case the "capitalization model" is used, the same rules that apply to companies that report according to IFRS (Eva Törning 2022).

2.2.3 R&D Expenditures Compared to Capital Expenditures

Comparing R&D expenditures with capital expenditures, the much stricter regulations regarding capitalization of R&D is important in evaluating the size of each respective investment. Baber et al. (1991) suggest that managers tend to minimize R&D expenses in case earnings risk being lower than the previous year as these expenses affect the earnings to a larger extent than what amortization of an investment in capital expenditures does. Graham (2005) further builds on this idea and states that about 80% of executives cut on R&D expenses in case that would make them reach a certain earnings threshold. However, Canace (2017) goes beyond this reasoning and looks deeper into how R&D expenditures and capital expenditures vary dependent on each other. They suggest, that instead of only cutting R&D expenses when the chance is high of missing an earnings threshold, the capital expenditures are increased. Overall investments are therefore not decreased in an earnings shortfall but held at approximately the same level, which in turn indicates that companies can keep having a long-term investment strategy. Since R&D expenses that cannot be capitalized, will affect the income statement negatively to a large extent it becomes a key factor in evaluating the size of the expenses (Canace, 2017).

2.2.4 Previous Studies and their Treatment of Accounting Regulatory

Reviewing previous works on the topic it can be concluded that few studies take the regulatory aspect of R&D expenses and how these affect the income statement into account. Ghosh et al. (2007) studies firms regulated by (SFAS no.2) and not IFRS, i.e., not the IAS38 regulation. According to the SFAS No2 regulatory, all R&D costs should be reported on the income

statement as expenses, the year it is incurred and are hence not capitalized as is the case with IAS 38 (FASB Accounting Standards Board, 2021). Having no possibility to capitalize R&D costs, Ghosh et al. (2007) sees as an increased reason to why R&D costs involve a lot of risk This statement is in line with previous reasoning and that a company's decision to report R&D expenses is much affected by how it affects the income statement.

2.3 Hypothesis Development

It is possible to conclude that there are several effects that come into play when studying CEO ownership and its relationship with innovation investments in R&D. From the above literature review the decision to invest in R&D can be explained by the *over & under-investment arguments* that are driven by the *incentive,* and the *entrenchment effect.* As previous results have been ambiguous, showing different results, two different tests will be maintained to elaborate on the relationship further. The first part of the hypothesis will test for whether CEO ownership of the firm has a positive effect on the investments made in R&D.

H1a: Ownership by a firm's CEO is Positively Related to R&D Expenditures

In addition to the first part of the hypothesis, Ghosh et al. (2007) and Hassanein et al. (2021) both indicate that an increased level of ownership does not result in a completely linear relationship with R&D investments. In line with Beyer et al. (2012), they argue for the *entrenchment effect*, suggesting that CEOs with a high level of ownership may invest in R&D at higher levels than what is considered value maximizing. Managers are not afraid of failing investments made in R&D, causing them to invest more in R&D. However, at an increasing level of ownership the expenditures decrease, forming a reversed u-shaped relationship between the two variables. To test for this non-linear relationship, the following hypothesis will be developed.

H1b: High Ownership by a Firm's CEO has a declining effect on R&D expenditures

3. Method

With this chapter the goal is to describe how the study has been maintained to test the hypothesis and how the results that are presented in chapter four have been generated. In general, this is a quantitative study where a multivariate regression analysis has been carried out to see if there exists any relationship between ownership levels and investment in R&D. When deciding on the method and what variables to include in the final regression Hassanein et al. (2021) has worked as the basis for this. When deciding on the proxy for how to analyze how different ownership levels affects R&D investments Ghosh et al. (2007) has been the basis. Section 3.1 describes how the data collection and the final sample have been generated. Section 3.2 presents how innovation has been measured and how the regression with its variables has been maintained.

3.1 Data

For this study the focus is on the Swedish market between the beginning of 2017 to the end of 2020. In Sweden, the largest stock exchange is handled by Nasdaq and includes OMX Stockholm (Large, Mid & Small cap). What exchange a company is listed on is decided based on its market value. A market value above one billion euro is listed on large cap, a market value between 150 million and one billion euro is listed on mid cap and a market value below 150 million euro. In addition to the various OMX exchanges there are also smaller stock exchanges, such as First North, which is also handled by Nasdaq (Nasdaq, 2022).[1] For this study the three different OMX Stockholm exchanges including First North will be studied.

The financial accounting data that is the basis for both the dependent and most independent variables (except for ownership and market capitalization) has been downloaded from the Compustat database that is a product of S&P Global Market Intelligence. To find ownership data, Holdings provided by Modular Finance has been used. As Holdings only have available ownership data going back until 2017 this has been set as the first year, creating a four-year period until the end 2020. Market capitalization data has been extracted from FinBas provided by the Swedish House of Finance.

[1] First North Stock Exchange is divided into two different sub-categories, “First North Growth” and “First North Growth Premier”. These will be discussed later in the report as they are regulated differently in terms of accounting regulatory (NASDAQ)

Table 1: Summary of data sources

Data Sources	Information
Holdings (Modular Finance)	CEO Ownership Data
Compustat (S&P Global Market Intelligence)	Financial Accounting Data
FinBas (Swedish House of Finance)	Market Capitalization

3.1.1 Sample Construction

After extracting the relevant data from its various independent databases, it has been merged to identify an original dataset. After merging the data, several adjustments have been made to create a dataset suitable for the regression. First, comparing the data extracted from Compustat with the data from Holdings, the Holdings data included more observations. From an initial dataset provided by Holdings of 2345 observations, merging it with Compustat, the dataset decreased to 1819 observations. Observations without data from Compustat but with data from Holdings were therefore excluded.

For 98 observations there was available data from Compustat but missing data from Holdings. For these cases, annual reports were analyzed manually to include ownership data for these observations. When maintaining the manual collection, some deliberations had to be made to ensure that it was comparable to the data presented in Holdings. Only shares that were held directly by the CEO or indirectly by a company over which the CEO controlled were included. Therefore, shares that were owned through holding companies by the CEO were included. In addition to this, shares that were owned by close relatives were also included. Furthermore, there were 43 observations from Compustat with missing data in some of the control variables, they were excluded in the dataset. Segmenting what industries the companies were active within, it was possible to see that 14 observations were active in the financial industry. In line with previous studies Hassanein et al. (2021) and Ghosh et al. (2007), observations from financial firms have been excluded from the study because of their different ownership structure compared to the other firms included in the study.

Finally, the Compustat data does not take on the value zero in the cells but is left empty. In accordance with the Ghosh et al. (2007), all observations with an empty cell for R&D expenses have been assumed to be zero R&D. This assumption will be considered when testing for robustness later in the report. After having done the mentioned limitations with the data, the final dataset ended up consisting of 1860 observations (see Table 2).

Table 2: Sample construction procedure

	Observations
Firm year observations of ownership for the period 2017-2020	2345
Firm year observations with missing compustat data	-526
Firm year observations with manually added Ownership data	98
Firm year observations with missing other regression variables	-43
Financial firms	-14
Total	**1860**

3.2 Multivariate Regression Analysis

3.2.1 Measuring Firm Innovation

To evaluate how innovation in firms is related to different levels of CEO ownership a measurement for innovation that gives a fair representation of reality is needed. As innovation is an uncertain phenomenon and a measure of new knowledge and technological progress it is hard to find an accurate measurement that is possible to be compared between industries and firms (Jalonen, 2011). Cohen and Levin (1989) suggest that innovation has empirically been measured both by inputs, such as costs and by outputs such as the number of patents. The problem with using an output measure like patents as an indicator of innovation they argue is that the likelihood of publishing a patent can differ a lot across industries. In some industries, patents tend to reveal secret technological developments which risks being copied, while in other industries this is not the case. Using patents as a measure of innovation, therefore, becomes an unrepresentative measurement that is not relevant to use for this study (Cohen and Levin, 1989).

Evaluating previous empirics, innovation is more often measured using R&D expenses, as it opens for better comparison between firms and excludes the effects of firm size or industry effects (Cohen and Levin, 1989). Shefer and Frenkel (2005) further demonstrate the importance of R&D expenditure in the context of innovation and see it as crucial to develop and foster future economic growth. From the above, it is reasonable to use R&D expenses as a measurement for innovation.

Maintaining a study based on a sample group with large differences in terms of company size, it is not possible to make a fair evaluation only using the R&D expenses in absolute numbers. In line with Ghosh et al. (2007) total R&D expenses will be divided by total assets (end of year)

so that a ratio is created. Using a ratio metric, not only gives a fair representation of how large expenses of R&D are, but also captures the size effect and opens for comparisons over time and across firms. The value of the ratio-metric will be employed as a continuous variable in the regression.

3.2.2 CEO Ownership & Categorization Into Groups

In line with Ghosh et al. (2007), CEO ownership is measured as the percentage out of the total outstanding common stock that is owned at the end of the fiscal year. The first hypothesis is tested by creating a dummy variable, which takes the number one, if the CEO holds ownership in the firm or not. Secondly, the data is segmented into different categories depending on the size of ownership held by the CEO. This has been done as Ghosh et al. (2007), Hassanein et al. (2021), Beyer et al. (2012) all show that different levels of ownership affect R&D expenditures in different ways. By segmenting the ownership data and dividing data points with approximately the same level of ownership into the same groups, it becomes possible to identify how different levels of ownership relates to expenditures in R&D and thereby to answer the second part of the hypothesis.

Building on the same idea as Morck et al. (2005) equity data will be broken down into different segments, to test for differences in how the level of CEO ownership affects R&D expenditures. Looking closer at the ownership data, it is not spread to the same extent as the data used in Morck's study but rather centered around 0%. Using 5% and 25% as breakpoints as suggested by Morck, therefore creates an uneven distribution with only a few data points in the higher ownership levels (see table 3) in section 3.3.1 Dividing the data into segments that consist of large differences in the number of observations creates a problem as it is not meaningful to have a segment consisting of only a few observations. Therefore, 0.05%; 0.5%; 5% & 25% will be used for this study as this helps create a more even distribution. With the help of dummy variables, the breakpoints will create 5 different subgroups of data that are used to explain the dependent variable in the regression. In more detail *CEO Ownership (0; 0.0005)* equals an ownership level below 0.05%, *CEO Ownership (0.0005; 0.005)* an ownership level higher than 0.05% but below 0.5%, *CEO Ownership (0.005; 0.05)* an ownership level higher than 0.05% but below 5%, *CEO Ownership (0.05; 0.25)* if the ownership level is higher than 5% but below 25% and lastly *CEO Ownership (0.25; 1)* if the ownership level is higher than 25% but below 100%.

Table 3: Sample and Ownership distribution over Percentages

Year	Freq (Percent)	R&D/TA
Ownership 0-5%	1522 (81.828)	0.057
Ownership 5-25%	234 (12.581)	0.062
Ownership 25-100%	104 (5.591)	0.034
Total	**1860**	**0.057**
No Ownership	202 (10.860)	0.031
Ownership	1658 (89.140)	0.060
Total	**1860**	**0.057**
Ownership 0-0.05%	494 (26.559)	0.039
Ownership 0.05-0.5%	530 (28.495)	0.070
Ownership 0.5-5%	498 (26.774)	0.063
Ownership 5-25%	234 (12.581)	0.062
Ownership 25%-	104 (5.591)	0.034
Total	**1860**	**0.057**

3.2.3 IAS 38 and the Right to Capitalize R&D Expenditures

Looking at previous works such as Hassanein et al. (2021) and Beyer et al. (2011), it can be concluded that these does not take the reasoning about accounting regulatory issues into account. Despite the implementation of IAS 38 and the obligation for firms to capitalize development costs as intangible assets, this report will follow the same approach as previous works and use R&D expenses reported on the income statement as a dependent variable. Therefore, the fact that R&D investments can be capitalized and reported on the balance sheet is not considered. The decision to exclude this information has been made due to major difficulties in finding relevant data for reported intangible assets that could help explain this relationship further. One thing to highlight is that due to not covering the capitalized development and only the expenses made on R&D, the full R&D is not tested for. However, R&D expenses should give a fair representation of the investment.

3.2.4 Additional Control Variables

In addition to CEO ownership, other control variables are also used. This as it is unlikely that CEO ownership is the only explanatory factor for how much is spent on R&D. Other variables are likely to affect certain investment decisions, which can also be related to the level of CEO ownership. By adding several control variables, the intention is to prevent an omitted variable bias to occur. Looking at the control variables in closer detail such as what control variables

should be included and how these should be measured, Hassanein et al. (2021) and Ghosh et al. (2007) constitutes a great deal of inspiration. By following these previous studies and using them as a proxy, it is reasonable to say that the control variables used are enough for its purpose.

Firm liquidity is a variable that will be used and is calculated as the ratio of current assets to current liabilities. As suggested by Baum et al. (2013) firms that plan to invest a lot in R&D tend to also increase their cash buffers, which indicates a need for internally generated funds. In the event a firm has large issues with liquidity constraints, there is likely to be lower investments in R&D. As liquidity has been found to be an important aspect in terms of R&D expenditure it is reasonable to use it as a control variable. *Capital expenditures* is the next variable that will be used as a control variable. According to Amir et al. (2007), investments in R&D and capital expenditure are closely related, where investing in capital expenditure tends to result in lower expenditures in R&D. This is something that affects the results of this study and thus should be included. Capital expenditure is calculated as a ratio of total capital expenditures and total assets at the end of each fiscal year. *Debt* level will be controlled for as firms with higher levels of debt tend to make fewer investments (Lang et al., 1996). They further show that the level of debt and growth have a negative relationship, something that will be important to control in the study. By measuring *debt* as a ratio of total debt out of total assets a continuous variable will be generated. *Cash flow* will be controlled as the level of cash flow has been proven to be an affecting parameter. Fazzari et al. (1988) suggest that the level of operating cash flow affects a firm's ability to invest in discretionary investments. With this study in mind, it is reasonable to say that *cash flow* should be an included control variable and will be approximated using operating cash flow scaled by the total assets (Ghosh et al., 2007). *Profitability* is indicated to positively affect how much is spent in R&D (Pindado et al., 2016). Therefore, it is reasonable to use earnings per share as a control variable. Firm *size* has been argued to have a positive effect on R&D investment and will be measured by a firm’s market capitalization at the end of each respective fiscal year (Bitler et al., 2005).

3.2.5 Industry and Year Fixed Effects

As this is a study looking at data from different years and different industries both industry and year fixed effects must be included. For example, the last year (2020) in the dataset was largely affected by the COVID-19 pandemic which could create large yearly differences in relation to the other yearly observations. By using fixed industry and year effects, changes across industry

and across time will be taken into account. Industry classification has been done by using a two-digit Global industry Classification Code (GICS) that has been extracted from the Compustat database.

3.2.6 Firm Fixed Effects.

Doing a multiple linear regression, one of the assumptions is that the sample needs to be homoscedastic. A test for heteroscedasticity is run by conducting a Breusch–Pagan/Cook–Weisberg test for heteroskedasticity. The test can be rejected on a 1% level, indicating that our sample is heteroscedastic. To account for this, we will also provide *Firm Fixed Effects* clustered by firm in panel 2 of our models, which according to Petersen (2009) limits autocorrelation and heteroscedasticity when doing panel data regressions.

3.3 Final Variables and Models

A summary of the variables in the models can be seen in Table 4, all variables have a short comment on the measure and the literature that support the use of the variable, longer argumentation can be found under 3.2 and 3.3 in the report.

Table 4: Summary of Variables

Variable	Label	Measurement	Literature
Research and Development Investments	R&D	Research and Development expenditure at the end of the fiscal year scaled by total assets at the end of the year	*Ghosh et al. 2007*
CEO Ownership	Ownership	Dummy variable to indicate wether the CEO owns shares or not at the end of each year.	Ghosh et al. 2007, Morck et al. 1988
Liquidity	FRM_Liquidity	Total expenditures divided by total assets at the end of the year	*Baum et al 2013*
Capital Expenditures	FRM_Capex	Firm capital expenditures divided by total assets at the end of the year	*Amir et al 2007*
Debt	FRM_Debt	Total Debt divided by total assets at the end of the year	*Lang et al. 1996*
Cash Flow	FRM_Cashflow	Operating Cash flow at the end of the year	Fazzari et al. 1988, Ghosh et al. 2007
Profitability	FRM_Profitability	Earnings per share at the end of the year	*Pindado et al. 2016*
Size	FRM_Size	Firm's market capitalization at the end of the year	*Bitler et al. 2005*

Note(s): This table shows definitions and measures of variables

The above variables all end up in the two models. The difference between the two models is how ownership is being tested for. In Model 1 R&D expenditures and how these are affected by ownership is tested without any segmentation of the different ownership levels. Ownership is instead tested for as a dummy variable where observations with a CEO ownership above 0% are separated from those with a CEO ownership of 0%. Observations with an ownership level above 0% are given the value 1 whereas observations with CEO ownership levels of 0 are given

the value 0. By this, Model 1 aims to purely test for the relationship and the direction of the two variables, including controls.

$$R\&D_i = \beta_0 + \beta_1 Ownership_i + \beta_2 FRM\_Liquidity_i + \beta_3 FRM\_Capex_i + \beta_4 FRM\_Leverage_i + \beta_5 FRM\_Cashflow_i + \beta_6 FRM\_Profitability_i + \beta_7 FRM\_Size_i + FE_i + \varepsilon_i$$

For the second model, ownership levels are segmented in line with the reasoning mentioned in 3.2.1 and by that to achieve a meaningful distribution. As discussed, this opens for testing how the size of ownership affects expenditures in R&D. This will test for the previously mentioned incentive and entrenchment effect as well as to see if there are any different relationships between R&D and CEO ownership depending on the size of ownership (non-linear relationship). The second model will have the same control variables as in Model 1.

$$R\&D_i = \beta_0 + \beta_1 Ownership_{(0,0.0005)i} + \beta_2 Ownership_{(0.0005,0.005)i} + \beta_3 Ownership_{(0.005,0.05)i} + \beta_4 Ownership_{(0.05,0.25)i} + \beta_5 Ownership_{(0.25,1)i} + \beta_6 FRM\_Liquidity_i + \beta_7 FRM\_Capex_i + \beta_8 FRM\_Leverage_i + \beta_9 FRM\_CashFlow_i + \beta_{10} FRM\_Profitability_i + \beta_{11} FRM\_Size_i + FE_i + \varepsilon_i$$

β_0 is the intercept used for this regression and represents the value of the model in case all other parameters are equal to zero. $\beta_1 \; to \; \beta_{13}$ are regression coefficients and describe the estimates the relationship between the independent and the dependent variable. ε is the error term and describes the differences between the actual observations and the values that the model suggests. *i* is the firm subscript. FE is Fixed effects of Year, Industry and in panel 2, Firm is added as a third FE.

Testing for the hypotheses, reviewing the coefficients of $\beta_1 \; up \; to \; \beta_5$ in the second model will indicate whether there is a positive or negative relationship with the dependent variable on the different levels of ownership. A positive coefficient will signal that there is a positive relationship with the dependent variable, whereas a negative will signal the opposite.

The models are predicted using two conditions, in Panel 1, Year and Industry fixed effects to control for variations among the years and characteristics of the industries that may influence R&D expenditures. Secondly in Panel 2, firm fixed effects, clustered by firm will be added to control for heteroscedasticity and potential autocorrelation problems (Petersen, 2009). The

continuous variables are winsorized at a 1% and 99% level to reduce any potential statistical effect of outlier values.

4. Empirical Findings

In this section the empirical findings will be presented. Section 4.1 will present the descriptive statistics followed by section 4.2 that presents the final multivariate regression analysis. The models are run multiple times to take industry, year, and firm fixed effects into account. Robustness checks are elaborated in section 4.3 to verify the quality and robustness of the total regression as well as to check for multicollinearity.

4.1 Descriptive Statistics

By tabulating the sample into descriptive (See Table 5), some divergence in the yearly data is identified. In 2017 there is a lower mean of R&D expenditures in comparison to the mean calculated for 2019. The yearly observations are evenly distributed but slightly skewed with an increasing number of firms every year. Looking at the increase in the number of firms, it could be considered to go in line with expectations, as new companies continuously have been listed on OMX Stockholm or First North in the last years.

Table 5: Sample and R&D distributions over Years

Year	**Freq (Percent)**	**R&D/TA**
2017	437 (23.495)	0.043
2018	454 (24.409)	0.059
2019	478 (25.699)	0.068
2020	491 (26.398)	0.058
Total	**1860**	**0.057**

Another indicator that is expected to be a driver of R&D is the industry in which a firm is operating. Out of the 1860 observations, 868 are within the industries, Health Care, and Information Technology (See Table 6). Those two industries alone, are drivers of raising the mean for the whole sample. All other Industries are notably below the mean. Most notably is the health care industry that on average invest 11.8% of their total asset base in R&D every year.

Table 6: Sample and R&D distributions over Industry

Year	Freq (Percent)	R&D/TA
Energy (10)	34 (1.828)	0.015
Materials (15)	106 (5.699)	0.008
Industrials (20)	438 (23.548)	0.025
Consumer Discretionary (25)	200 (10.753)	0.019
Consumer Staples (30)	62 (3.333)	0.003
Health Care (35)	514 (27.634)	0.118
Information Technology (45)	354 (19.032)	0.069
Communication Services (50)	124 (6.667)	0.037
Utilities (55)	20 (1.075)	0.006
Real Estate (60)	8 (0.430)	0.001
Total	**1860**	**0.057**

Reviewing the continuous variables in Table 7, it can be noted that there is a large skewness in many of these. The mean is above the 75% percentile in six out of nine variables, and above the median in eight out of nine variables. An R&D expenses to total assets ratio of 2.7 is high in relation to the other industries. However, since some of the health care firms are in an early phase of their lifecycle, with a small asset base and large spending on R&D, the high ratio is explained. Looking at the overall data on ownership it can be identified that it is in the lower interval at a level around 0-5% suggesting that few observations have a CEO ownership that exceeds the 5% level.

Looking at the *liquidity* ratio the highest identified ratio value is 187, which can be compared to a mean value of 3.523. Looking deeper into this observation, it is reported from a holding company (financial industry), with large current assets in relation to its almost non-existing current liabilities. Due to its high value and the fact that it possibly should not be classified in the energy sector but the financial sector, it could be excluded. However, that is not done in this case and the observation is included in the final regression as it has received the GIC-classification of energy and chose to follow that to follow our method. The highest observation for the Capital expenditures-ratio, 1.3 is also high in relation to its mean value of 0.024. Reviewing this observation, the company made large impairments during the end of that year. Finally, reviewing earnings per share "EPS" the highest value of 212.444 is also high in relation to the mean value. This is explained by a one-off event in the observed firm.

Table 7: Continuous Variables

	Obs	Mean	Std. Dev	Min	25%	Median	75%	Max
R&D	1860	0.057	0.155	0,000	0,000	0.004	0.045	2.702
Ownership	1860	0.040	0.091	0,000	0.000	0.003	0.023	0.627
FRM Liquidity	1860	3.523	7.294	0.005	1.106	1.728	3.384	187.647
CAP Expenditure	1860	0.024	0.057	0,000	0.002	0.009	0.024	1.302
FRM Leverage	1860	0.113	0.149	0,000	0,000	0.050	0.178	0.995
FRM Cash flow	1860	-0.103	0.390	-6.838	-0.201	0.026	0.108	1.012
FRM Profitability	1860	1.850	10.505	-40.029	-1.028	-0.039	3.197	212.444
FRM Size	1860	10120.50	38125.41	3.16	166.19	562.18	3258.88	494361.50

4.2 Results of Regressions

4.2.1 Testing for CEO Ownership with Dummy Variable (H1a Hypothesis)

By using the models previously specified in 3.3, this section aims to test how CEO ownership level affects R&D spending in Swedish listed firms. Two different regressions are maintained where one focuses on how ownership affects R&D expenditures in comparison to no ownership and the other regression focuses on how different levels of ownership affects expenditures made in R&D.

For the first regression observations having CEO ownership larger than zero are separated from observations with zero CEO ownership, which is done using a dummy variable. Table 8 presents the findings of the multivariate regression analysis from Model 1. Both industry and year fixed effects are controlled for in panel 1a, whereas Panel 2a also includes firm fixed effects. Model 1 is statistically significant for both panels at the 1% level. The model shows an adjusted R squared value in Panel 1 of 22.2% and 78.3% in Panel 2. The T-stats are shown in parentheses.

Starting with panel 1a, the coefficient for the independent variable *ownership* is 0.030 (t=3.82) with significance at the 1% level. This suggests that all else equal, a CEO that owns shares in the company affects R&D spending positively, by a 3 percentage points higher *R&D* ratio, than without ownership. The results are consistent with the first hypothesis, suggesting a positive relationship, and the null hypothesis *H1a* can thus be rejected. This shows that CEO ownership in the firm is positive for investments in R&D. Looking at the control variables, *operating cash flow* has a negative relationship with R&D expenditures, being significantly negative at the 1% level. This suggests that having a negative operating cash flow is positive for R&D spending.

Additionally, *firm size* has a significant positive relationship with investment in R&D at the 5% level, suggesting that larger firms invest more in R&D than small firms. *Debt* is significantly negative for R&D investments at the 0.10 level, suggesting that firms with debt invest less in R&D.

In Panel 2a, where firm fixed effects are considered the test shows no significant relationship between ownership and investments in R&D. For the control variables, *cash flow* has a negative relationship with R&D expenses, being significantly negative at the 1% level in accordance with panel 1a. This suggests that having a negative operating cash flow is positive for R&D spending. *Liquidity* is significantly negative at the 1% level, suggesting that firms with a high liquidity ratio invest less in R&D.

Table 8: Ownership & R&D		Model 1	
Year	**Expected sign.**	**Panel 1a**	**Panel 2a**
Intercept		0.019	0.050
Ownership	+	0.030*** (3.82)	-0.004 (0.75)
FRM Liquidity	+	-0.001 (-1.09)	-0.004*** (-5.21)
FRM Capex	-	0.013 (0.18)	-0.000 (0.00)
FRM Debt	-	-0.037* (1.95)	0.015 (0.71)
FRM Cash flow	+	-0.126*** (-15.36)	-0.105*** (-12.08)
FRM Profitability	+	-0.000 (-0.84)	0.001 (1.18)
FRM Size	+	0.000** (2.26)	-0.000 (1.14)
Year and Industry Fixed effect		Yes	Yes
Firm Fixed effects		No	Yes
F		43.75***	30.48***
Adjusted R squared		0.222	0.783
Observations		1860	1823

Note(s): The table above shows the multivariate result from Model 1. Panel 1 show the results when controlling for Year and Industry Fixed effects. Panel 2 show the results when adding the control for Firm fixed effects. *, **, *** significance at 10%, 5% and 1%, respectively. T-stats are shown in parenthesis.

4.2.2 Testing for CEO Ownership with Different Breakpoints (H1b Hypothesis)

In the second model, the different ownership levels have been segmented to test if an increased ownership results in a negative or positive effect on R&D investments. This makes it possible to see if an increased ownership level leads to a linear relationship of R&D expenditures, or if the expenditures vary depending on ownership level.

Table 9 shows the multivariate findings of Model 2. In Panel 1b the model is controlled for Year and Industry fixed effects, whereas Panel 2b also includes firm fixed effects. For both panels, the model is statistically significant at the 1% level. For model 2, the two panels have an adjusted R squared value in Panel 1b of 22.1% and 78.5% in Panel 2b. T-stats are shown in the parenthesis next to the coefficient.

Starting with examining the results from Panel 1b, the results for the coefficient ownership between 0.05-0.5% is 0.019 (t=2.83) with significance at the 1% level in panel 1b. This suggests that ownership between 0.05-0.5% is significantly positive for investments in R&D. However, the aim of this test was to test how increased ownership affects R&D and if the coefficient changes depending on what level of ownership the CEO has. The test shows a negative coefficient for ownership above five percent, although insignificant. It is therefore not possible to reject the null hypothesis for hypothesis H1b, as it is not possible to significantly identify a declining relationship on the higher levels of ownership. Both *debt* and *cash flow* are negative for this panel, showing the same relationship as identified in model 1. *Firm size* is shown to have a positive effect on R&D spending, in accordance with both previous studies and the regression above.

In Panel 2b the coefficient for ownership between 0.05-0.5% is 0.012 (t=2.19) with significance at the 5% level. However, in Panel 2b the model shows that ownership between 5-25% has the coefficient 0.018 (t=1.77), being significantly positive for investments in R&D on the 10% level in contrast to the negative insignificant result in Panel 1b. Studying the other breakpoints, the model is insignificant, although changing signs. In terms of control variables, both *cash* flow and *liquidity* has a negative effect when taking firm fixed effects into account.

Table 9: Ownership breakpoints & R&D		Model 2	
Year	**Expected sign.**	**Panel 1b**	**Panel 2b**
Intercept		0.039	0.048
Ownership 0.05-0.5%	+	0.019*** (2.83)	0.012** (2.19)
Ownership 0.5-5%	+	0.007 (0.98)	0.002 (0.32)
Ownership 5-25%	-	-0.003 (-0.36)	0.018* (1.77)
Ownership 25%-	-	-0.009 (-0.74)	-0.019 (-1.33)
FRM Liquidity	+	-0.001 (-1.26)	-0.004*** (-5.19)
FRM Capex	-	0.011 (0.15)	0.000 (0.00)
FRM Debt	-	-0.036* (-1.87)	0.015 (0.71)
FRM Cash flow	+	-0.126*** (-15.27)	-0.105*** (-12.09)
FRM Profitability	+	0.000 (-0.91)	0.001 (1.20)
FRM Size	+	0.000** (2.72)	-0.000 (-1.06)
Year and Industry Fixed effect		Yes	Yes
Firm Fixed effects		No	Yes
F		30.42***	22.57***
Adjusted R squared		0.221	0.785
Observations		1860	1823

Note(s): The table above shows the multivariate result from Model 2. Panel 1 show the results when controlling for Year and Industry Fixed effects. Panel 2 show the results when adding the control for Firm fixed effects. *, **, *** significance at 10%, 5% and 1%, respectively. T-stats are shown in parenthesis.

4.3 Robustness Tests

To check for robustness, several tests will be maintained with the aim of generating the same results as the original ones. This will be done by running the same regressions but with minor changes to see if the same results will be generated as well as conducting tests for multicollinearity.

4.3.1 Tests of Robustness

First, Model 1 and Model 2 is tested for, but now excluding the observations with 0 in R&D expenses (Ghosh et al., 2007). By excluding all data points with 0 the sample is reduced to 1082 observations. Both tests are significant at the 1% level. Although Model 1 seems to have a good fit, with an adjusted R squared of 39.77% and significance at the 1% level, it shows no significant relationship between CEO ownership and R&D investments. For Model 2 no significant results are generated in terms of the relationship between R&D and CEO ownership.

As a second test, model 2 is run again but now with different breakpoints, segmenting the data differently compared to the original test. In accordance with Morck et al. (2005) the ownership data is segmented using 5% and 25% as breakpoints. Testing for these breakpoints, a negative result in line with previous studies is generated. However, the results are insignificant with p values of 0.104 and 0.104 respectively, just outside the significant threshold.

Table 10: Sample and Ownership distribution over Million SEK

Year	**Freq (Percent)**	**R&D/TA**
Ownership 0 MSEK	202 (10.860)	0.031
Ownership -2 MSEK	593 (31.882)	0.083
Ownership 2-10 MSEK	455 (24.462)	0.045
Ownership 10-30 MSEK	290 (15.591)	0.059
Ownership 30+ MSEK	320 (17.204)	0.041
Total	**1860**	**0.057**

A third test is done by using million SEK as a divisional base instead of different percentage levels. For this test the ownership level is divided evenly based on how large ownership that is owned by the manager (see table 10). This is done by multiplying the number of shares owned with share value at the end of the year. In table 11 the multivariate results of Model 3 are shown. Panel 1c in the model control for both Year and Industry fixed effects, whereas panel 2c also takes firm fixed effects into account. The model is statistically significant at the 1% level for both panels. The models adjusted R squared is 22.4% for Panel 1c and 78.4% for Panel 2c. The T-stats are shown in parentheses.

Throughout the different thresholds, the coefficient for ownership in Panel 1c is positive and significant at the 1% level, except for the segmentation between 2 and 10 MSEK, which is significant at the 5% level. This suggests that ownership when measured in MSEK is positive for the firms' expenditures on R&D on all ownership levels. This result confirms the first model, that ownership is positively related to the spending on R&D and is in line with the positive results generated in model 2. Taking the firm fixed effect into account, no significant relationship can be identified.

Table 11: Ownership with MSEK breakpoints & R&D		Model 3	
Year	**Expected sign.**	**Panel 1c**	**Panel 2c**
Intercept		0.018	0.051
Ownership -2 MSEK	+	0.035*** (4.10)	0.007 (1.19)
Ownership 2-10 MSEK	+	0.020** (2.21)	-0.001 (-0.19)
Ownership 10-30 MSEK	+	0.035*** (3.55)	0.005 (0.67)
Ownership 30+ MSEK	+	0.030*** (3.18)	-0.004 (-0.39)
FRM Liquidity	+	-0.001 (-1.05)	-0.003*** (-5.10)
FRM Capex	-	0.001 (0.14)	0.008 (0.11)
FRM Debt	-	-0.035* (-1.84)	0.014 (0.65)
FRM Cash flow	+	-0.126*** (-15.13)	-0.104*** (-11.92)
FRM Profitability	+	-0.000 (-0.75)	0.000 (1.11)
FRM Size	+	0.000** (2.35)	-0.000 (-1.07)
Year and Industry Fixed effect		Yes	Yes
Firm Fixed effects		No	Yes
F		31.32***	21.79***
Adjusted R squared		0.224	0.784
Observations		1860	1823

Note(s): The table above shows the multivariate result from Model 3. Panel 1 show the results when controlling for Year and Industry Fixed effects. Panel 2 show the results when adding the control for Firm fixed effects. *, **, *** significance at 10%, 5% and 1%, respectively. T-stats are shown in parenthesis.

To consider that scaling with total assets might be a bad numerator due to the asset base being affected by the accounting regulatory to capitalize R&D expenditures, investments in R&D are also scaled using total sales (Ghosh et al., 2007). For model 1 using sales as the numerator instead of total assets, a positive relationship between R&D and ownership is identified at the 5% significance level. Scaling with sales for Model 2, a significant relationship at the 5% level, both for ownership between 0.05-0.5% with (t=2.16) and ownership between 0.5-5% with (t=2.54) is found. This supports the positive relationship between ownership and R&D that has been found in the other conducted tests.

Table 12: Table of lists and accounting regulatory used

List	Freq (percent)	R&D/TA
Large cap (IFRS)	282 (15.161)	0.025
Mid cap (IFRS)	360 (19.355)	0.065
Small cap (IFRS)	288 (15.484)	0.058
First North (IFRS)	336 (18.065)	0.072
First North (K3)	594 (31.935)	0.058
Total	**1860**	**0.057**

To test additionally for accounting regulatory and how this affects R&D spending, both models are also run separating the observations based on whether they report according to IFRS or K3. Maintaining this robustness check, no significant differences from the original test are reported suggesting that whether firms report according to K3 or IFRS not to impact the results.

Finally, a yearly effect is tested to control for any eventual effects of Covid-19. As 2020 was the most Covid-19 affected year, we run the models for 2017-2019 and for 2020, to test how much it affects the results. Maintaining the same tests provides equivalent results with similar significance for both models, confirming the robustness of the model.

Overall, throughout the robustness checks, similar signs and significance levels for the control variables are identified. Most notably *cash flow* has a negative impact on investments in *R&D*, suggesting that a negative operating cash flow increases the expenses in R&D and vice versa. This is a phenomenon that will be further elaborated on in the discussion.

4.3.2 Test for Multicollinearity

To provide even more insight into the data and to acknowledge significant correlations between the variables, a Pearson correlation test has been conducted. The test shows multicollinearity within the independent variables in the dataset, where multicollinearity is when two or more of the variables in the regression have a significant linear correlation, i.e., that one of the independent variables can be explained by one of the other. Having high multicollinearity between variables reduces the explanatory value of the coefficients, as it impairs the independence of the independent variables, and thus the whole regression. With the coefficients of the Pearson correlation all being below 0.80 (see *Appendix 1*), according to Petersen (2009) there is no problem with multicollinearity provided for our variables. To further control for multicollinearity a VIF-test (Variance Inflation Factors-test) is conducted. The VIF-test

confirms that there is no problem with multicollinearity among the variables, with the mean VIF being 1.08 and the highest value 1.15. The VIF-test can be found in *Appendix 2*.

5. Discussion

In this section the results will be discussed to elaborate on the hypotheses that are presented in section 2.3. First the data selection is discussed, followed by a brief discussion on the descriptive statistics. Lastly the results of the regression and how these go in line with the presented hypotheses will be discussed with regards to theory and previous works written on the topic.

5.1 Research method

5.1.1 Data selection

As described in 3.1.1 the sample collection has resulted in removing several observations that naturally can influence the sample and hence affect the significance and outcome of the results. Many of the reductions in the observations are a consequence of merging multiple datasets together, as no database provides exhaustive information needed for this study. Maintaining this kind of data collection has quite randomly removed some observations, something that might have resulted in a sample that is a misrepresentation of reality. For example, the final sample consists of 514 observations from the R&D intensive industry, health care. This suggests that the sample consists of almost 28% firms that are classified as health care firms. On the other hand, data from the actual exchanges suggests that health care firms make up only 19% of the studied exchanges (NasdaqOMXnordic, 2022). This suggests that the dataset is not random and that a selection bias could be present. However, as our sample excludes financial firms and only have eight firm year observations from the real estate sector excluding those from the original exchanges could give a more representative comparison to our sample. By doing that, health care firms constitute 23% of the total exchanges, suggesting that our sample is a fair representation of reality and that a selection bias is less likely to be present.

In addition to this, as this study includes many different stock exchanges it naturally includes many different firms in terms of size and development stage for the studied years. This should be considered to abate the potential risk of selection bias. To limit the risk even further and create a larger spread of companies all Nordic companies could have been included. However,

due to the limitations in collecting ownership data this has not been maintained. By only studying Swedish firms and downloading data from respectable sources, a high quality of the observations is ensured.

5.2 Analysis of Results

5.2.1 Descriptive statistics

Starting with observing the different years in the study, just minor differences can be identified among them. In 2019 the new accounting standard *IFRS 16* regulatory was implemented, suggesting that all leasing expenses should be capitalized as assets (IFRS Foundation, 2022). A natural consequence would be for the reported assets to become larger, and thus have a lowering effect on the R&D ratio given equally large R&D expenditures. However, this seems to not be the case in our sample. Despite an increased asset base for 2019 and 2020, the R&D ratio is still higher for both years compared to before this regulation was implemented, suggesting for that the R&D expenses must have increased. A plausible explanation to this could be for the lowered leasing expenses to give room for higher R&D expenses.

One thing that can be noticed from the sample is that it includes many observations from the health care industry which has a higher mean in comparison to the other industries. The reported mean for *R&D/TA* is 11,8% for the *health care industry*, while the second largest industry have a *R&D/TA* level of 6.9%. Notable is that these industries are the only ones having a value above the sample mean, thus raising it for the whole group. However, Jaruzelski et al. (2018), suggest that the health care industry should outspend all other industries by 2020. From this it can be concluded that the high reported ratio by health care firms is in line with previous findings. In addition to this, studying these observations closer by reviewing annual reports, many of the health care firms have a smaller asset base, mainly consisting of cash in combination with high R&D expenditures, thus creating a high ratio.

Studying the descriptive statistics on the ownership and the R&D ratio, the different ownership levels have different means. At levels between 0-0.05% and levels above 25% the ratio is beneath the sample mean, while ownership between 0.05-25% is above the sample mean. Previous studies have shown similar relationships, but as was seen in the results of the regressions, the relationships cannot be shown with statistical significance in this study.

5.2.2 Hypothesis (H1a)

Building on the *incentive effect* and *entrenchment* effect, hypothesis (H1a) suggests that a CEO's Ownership should be positively related to investments in R&D. In the first regression with the main sample and dependent variable *R&D*, the main independent variable *Ownership* has a coefficient of 0.030 at a 1% significance level. From these findings, the null hypothesis can be rejected, suggesting that the *CEO Ownership* is positive for investments in *R&D*. This is in accordance with Ghosh et al. (2007) and Hassanein et al. (2021) and thus confirms the identified positive relationship for US and UK firms to also apply to Swedish firms. The results support the *incentive effect* suggesting that ownership in the firm increases a manager's incentive with shareholders and thereby its willingness to invest in long term and risky investments. However, it is likely that the *entrenchment effect* also helps explain the positive relationship. As suggested by Beyer et al. (2012) managerial ownership gives less power to other owners, which allows for managers to pursue strategies that are in the interest of themselves rather than in the company's best (value maximizing) interest. Over-investing in R&D is a natural consequence of the *entrenchment effect* as this tends to increase firm size which has been shown to result in managers being able to take advantage of various perquisites such as increased salaries. By managers having an ownership in the firm, the chances of pursuing private benefits therefore become higher and hence explains a manager's decision to over-invest. The positive relationship between CEO ownership and investments in R&D is therefore likely to be a combination of the both the *incentive and entrenchment effect.*

Taking the firm fixed effects into account, no significant results are achieved for the test, which might be a consequence of the lessened variation among the variables due to the firm fixed effects. Testing the robustness of hypothesis H1a, tests excluding the observations with missing R&D data were run, showing no significance. One issue that can be identified with regards to this robustness test is however that Compustat reports both zero and missing values as blank observations. By this it is not possible to single out the two from each other, causing both types of observations to be deleted maintaining the robustness test. The reliability of this robustness check can therefore be questioned. However, the other robustness tests that are used in the regression confirms the results in the main regression which suggests for reliable results.

5.2.3 Hypothesis (H1b)

In addition to the first part of the hypothesis (H1a), this part (H1b) aims to elaborate further on the investment behavior for various ownership levels. From panel 1b, the only significant result is achieved at an ownership level between (0.05-0.5%) where CEO ownership has a positive coefficient of 0.019 on the 1% level with R&D expenditures. As suggested by Ghosh et al., (2007), Hassanein et al. (2021) and Beyer et al. (2012) this positive relationship at low ownership levels is explained by the *incentive effect*, where the interests of managers become more aligned to those of the shareholders which causes managers to invest more in R&D. As no significant results are achieved in any other ownership intervals no conclusions can be drawn with regards to this from the original regression only taking year and industry fixed effects into account.

By also taking the firm fixed effects into account in panel 2b, CEO ownership at a level between (5-25%) positively affects investments in R&D, with the coefficient 0.018 at the 10% significance level. This contrasts with the panel 1b results where no significance can be identified. In line with Beyer et al. (2012) this is in the ownership region where the *entrenchment effect* is more likely to be the explanatory factor for an increasing expenditure in R&D. At this ownership level, managers are likely to invest in R&D at a level that exceeds that of firms that 100% owner led, and thereby in the level that should be considered value maximizing from shareholders point of view. Therefore, the positive relation in the (5-25%) ownership region suggests for an *over-investment* in R&D, where it is likely that investments are a result of managers wanting to pursue private benefits, rather than trying to implement an investment strategy in the company's/shareholder's best interest.

5.2.4 Discussion with Regards to Beyer's Findings

Comparing this study with the one maintained by Beyer, they look at how 100% owner-led firms invest in R&D and compare this with manager-led firms (not owning 100%). Based on agency issues they suggest 100% owner-led firm, by being value-maximizing, act in total alignment with its owners. This is compared to manager-led firms where it is likely for conflict of interests to arise, for example by managers pursuing private benefits, rather than striving for a value maximization of the company. For this study, the framework presented by Beyer et al. (2012), makes it possible to see when the *incentive and entrenchment effects* are likely to be present. However, as this study is based on listed firms, no observations with 100% owner-led

firms are included, which makes it impossible to have a similar "reference point" for investments in R&D. This in turn makes it hard to identify exactly when the different effects are likely to affect, something which makes the conclusions depend a lot on previous findings.

However, a critique towards Beyer et al's study is that the "optimal R&D level" is quite theoretical and does not have to be a fair representation of reality. As R&D investments is an uncertain investment there are probably more factors that are important to consider in addition to the principal-agency issues that are emphasized by Beyer.

5.2.5 Cash Flow Affecting R&D Investments Negatively

In contrast to what could be expected, *Cash flow* had a clear negative relationship with investments in R&D throughout all tests, suggesting that a negative operating cash flow leads to increased investment in R&D. This is indicated by the *Cash flow* coefficient being negative throughout all tests conducted at a 1% significance level. To control for possible lag effects between *R&D investments* and *Cash flow*, suggesting for investments to rather be driven by previous year's investment levels, both lagging and leading variables have been used. However, both these tests show the same negative relationship between *cash flow* and *R&D investments* as identified in the original models. The reason for this is not clear but could be that the sample consists of many firms with negative cash flows which can be identified by the *Cash flow* variable having a negative mean. Another explanation could be that investing in R&D leads to an instant expense but not instant payoff, which in turn causes the operating cash flow to decrease.

5.2.6 Commentary on Robustness Check

A potential issue with measuring CEO ownership in percentage is that CEOs might have trouble achieving a large share of the ownership in the company they operate, due to many firms being extremely large. This suggests that CEOs can hold a substantial amount in monetary terms, despite not owning a large amount of the total outstanding shares. From a private economic point of view, a CEO can thereby be highly exposed to the company's development, something which could be a deciding factor in their willingness to take risks. Despite this, Jensen & Meckling (1976) argues that it is the percentage owned in the firms is the deciding factor for the agency issue, and not the ownership measured in monetary terms. Looking at our robustness test, segmenting the ownership level in monetary terms rather than

in percentage, it can be identified that R&D expenditures are positively related by CEO ownership throughout all ownership levels. This suggests that the more a CEO owns in monetary terms is positively related to how large expenditures are in R&D, confirming the first hypothesis.

6. Conclusion

This section aims to draw conclusions about the study, present its limitations and provide suggestions for future research on the topic.

6.1 Contributions

In brief, this study aims to discover a rather unresearched area on the topic of innovation, agency problems, and corporate governance. This is maintained by studying how CEO ownership relates to investments made in research and development. To answer the hypotheses, a multivariate regression analysis has been maintained for Swedish firms listed on (OMX Stockholm and First North stock exchanges) between the years 2017-2020. Our study contributes to the literature on CEO ownership and R&D, as it is a topic that has not been studied to a large extent before. In total two different regressions have been done, one focusing on how CEO ownership affects investments in R&D and the other looking deeper in whether different ownership levels can give any explanatory value for the level of investment. The subject of our study is of interest for CEOs and shareholders in companies that seek to invest in R&D and innovation as to maximize shareholder value and mitigate agency related costs.

The results support the first part of the hypothesis, suggesting that ownership positively relates to investments made in R&D. This finding confirms Ghosh et al. (2007), Hassanein et al. (2021) and Beyer et al. (2012) previous studies on the relationship, who have all found the same positive relationship. The second part of the hypothesis, suggesting for R&D expenditures to decline at higher levels of ownership, cannot be rejected. This as it is only possible to find a significant positive relationship at low/ medium ownership levels, but not any significant result at higher levels. By this result it is not possible to show that higher ownership levels should be related to declining levels of R&D expenditures, something that both Ghosh et al. (2007), Hassanein et al. (2021) and Beyer et al. (2012) find support for.

In comparison to ownership levels and R&D expenditures, ownership levels and how this affect value creation is a more studied topic. Morck et al. (1988) suggests that increasing ownership levels tend to increase firm value at low levels of ownership but decrease firm value at higher ownership levels, suggesting for a non-linear relationship between the two variables. In the context of innovation, the results suggested in this report can partly help explain this phenomenon. By increasing the level of ownership at low levels, the CEO's interests are likely to become more aligned with the shareholders thus minimizing under-investment in R&D and thereby possibly lead to an increased firm value. On the other hand, increasing the ownership level at high levels, also increases the risks for the CEO to pursue private benefits. With the hope of creating a larger firm and take advantage of the perquisites that this results in, it is possible that a manager having a larger ownership level adapts an *over-investment* strategy, suggesting for the firm value to fall.

6.2 Limitations

We acknowledge there are some limitations with our study with one of them being that we solely cover the CEO ownership rather than the full managerial ownership. This leads to us having lower ownership levels in comparison to Hassanein et al (2021) and Beyer et al (2012), which should be accounted for as the CEO is not alone in the decision making. By studying the full managerial ownership, it would be possible to include observations with larger ownership levels. Focusing on CEO ownership rather than full managerial ownership might be an explanation to the insignificant results that we achieved, as more persons than the CEO are likely to affect the decision to invest in R&D. Another limitation for this study and its conclusions, is that we have not covered the full R&D investments companies make. This, as we have only studied the expenses as reported in the income statement, rather than both the expenses and the capitalization that IAS38 accepts.

6.2 Future Research

During the development of this study, several interesting additions and further research areas have come to mind. As there is not any available ownership data in Sweden for an earlier period than 2017 it would be interesting to do a similar study in a few years. This would make it possible to get a more comprehensive dataset and thereby a better understanding of what drives R&D investments. For example, Covid-19 seem to have had a large impact on society in terms

of technological change. Therefore, it would be interesting to maintain a study, comparing the investment behavior prior and after the pandemic.

Due to limitations in financial accounting, it was not possible to study the relationship of capitalized development in accordance with IAS38 in this study. However, it is still interesting to study the relationship further, as it could give insights into what types of firms capitalize their development costs and whether different ownership levels could be related to higher capitalization levels. The relation is of interest as a higher level of capitalization positively affects the income statement, something that managers are often evaluated based on. Further research on this could also be to see if there are any differences between IFRS and domestic accounting regulations.

Looking at the results, some of our control variables showed opposite signs in comparison to what previous studies had shown. One explanation for this might be that some of the used sources have been conducted their research in a time when large and profitable firms were the ones mainly investing in R&D. However, nowadays small firms with negative cash flow without earnings can invest heavily into R&D, something that was rarely done historically. A plausible explanation to this might be a more efficient financing and higher willingness to take risk among investors today. Maintaining a more comprehensive study on R&D expenditure would make it possible to see whether there has been a shift in what are the main drivers behind investments made in R&D.

A possible study to elaborate on our findings could be to do a similar study as Beyer et al. (2012). Looking deeper at 100% owner-led firms in the Swedish context it would be possible to find an optimal R&D expenditure level in the context of agency theory. This could be compared with manager-led firms and how much they invest in R&D. This would open for more precise conclusions on when the *incentive* and the *entrenchment effect* are likely to affect the decision to invest in R&D.

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Appendices

Appendix 1: Pearson correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) R&D	1,000							
(2) Ownership	-0,060** (0,010)	1,000						
(3) FRM Liquidity	0,041* (0,079)	-0.036 (0,122)	1,000					
(4) FRM Capex	-0,0512** (0,027)	-0,019 (0,423)	-0,073*** (0,002)	1,000				
(5) FRM Leverage	-0,175*** (0,000)	-0,035 (0,134)	-0,187*** (0,000)	0,130*** (0,000)	1,000			
(6) FRM Cash flow	-0,372*** (0,000)	-0,011 (0,645)	-0,061*** (0,008)	-0,166*** (0,000)	0,222*** (0,000)	1,000		
(7) FRM Profitability	-0,122*** (0,000)	-0,020 (0,381)	-0,045* (0,054)	0,020 (0,400)	0,054** (0,021)	0,201*** (0,000)	1,000	
(8) FRM Size	-0,042* (0,069)	-0,037 (0,114)	-0,065*** (0,005)	0,031 (0,183)	0,132*** (0,000)	0,145*** (0,000)	0,191*** (0,000)	1,000

Note(s) This table presents the Pearson correlation matrix among continuous variables. The p-values are presented in brackets *, ** and *** mean that correlation is significant at 10%, 5% and 1% levels (2-tailed), respectively

Appendix 2: VIF Analysis

Variable	VIF	Tolerance
FRM Cash Flow	1,15	0,867
FRM Leverage	1,13	0,888
FRM Profitability	1,08	0,93
FRM Capex	1,07	0,937
FRM Size	1,07	0,939
FRM Liquidity	1,04	0,958
Ownership	1,00	0,995
Mean VIF	1,08	

Note: Tolerance is defined as 1/VIF