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Innovation on shareholder breadth: evidence on how research and development expenses effect the number of shareholders

Author: Beerend van der Plas

Student number: 622991

Thesis supervisor: Sjoerd van den Hauwe

Second reader: Ruben de Bliek

The views stated in this thesis are those of the author and not necessarily those of the supervisor, second reader, Erasmus School of Economics or Erasmus University Rotterdam.

Abstract

This thesis provides empirical evidence that the level of a firm's innovation, measured as research and development expenses, has important consequences for the stock market. More specifically the paper shows that firms with greater R&D expenses, have a smaller number of shareholders. However, if the number of common shares outstanding is get larger, the breadth of ownership grows along. The interaction between R&D and advertising expenses shows a negative coefficient, indicating that high expenditures in these areas can reduce shareholder breadth.

Keywords: Innovation, ownership, advertising

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Chapter 1 Introduction

''Price is what you pay. Value is what you get''. This insightful comment by ''the Oracle of Omaha'' Warren Buffet is particularly relevant when considering R&D investments. Shareholders often take into account the value of a firm in the long run, which is significantly shaped by resource allocation for innovation (L. Kogan et al., 2017). Innovation can have significant results on a firms' finances and its shareholders. Innovation missteps can have notable repercussions, for example for the company Theranos. The company, led by Elizabeth Holmes, invented a revolutionary, new blood-testing system. However, the new innovation backfired, the technology did not work as promised, leading to the firms' bankruptcy and massive financial losses for its investors (The New York Times, 2021). Nonetheless innovation can also have positive consequences, for example when looking at pharmaceutical company Johnsen & Johnsen. The company forecasted strong growth driven by its MedTech and innovative Medicine sectors, leading to accelerated future innovation and delivering value to shareholders (Johnson & Johnson, 2023). These examples underscore the significance of innovation as a crucial and compelling field of study.

Moreover, in the investment world, shareholder breadth is particularly important, as it mirrors the diversity and number of investors who choose to engage with a firm's future (J. Chen et al., 2002). Making the dynamics between innovation and shareholder breadth essential for understanding investor and market behaviour. In recent events, such as the push for sustainable technologies, the adoption of AI across industries and innovative companies with significant spending in R&D might experience a larger shareholder breadth (McKinsey, 2024). This thesis aims to answer the relationship between a firms' innovation, measured as research and development expenditures, and its shareholder breadth. This thesis offers insights that help firms and investors, highlighting the role of innovation in modern investment landscapes.

There seems to be a gap in the literature concerning how innovation effects a firms' shareholder breadth. Shining more light on this subject is crucial to understand how innovation can attract new investors, enhance their firm's financial stability and studying the impact innovation has on shareholder breadth helps to understand the sustainability of business models and strategies over time. This paper will delve deeper into the interaction effect of advertising expenses and research and development expenses on the number of common shareholders. Investigating the interaction effect is interesting due to both advertising and innovation can influence investor perception and behaviour towards a company. Not to forget that advertising and R&D send different signals to the market, advertising sends a short-term signal and R&D sends a long-term signal. By examining the interaction, firms will have more insights on how these signals together effect the breath of shareholders. Moreover, Grullon et al. (2004) used a

final sample of 5776 firm-year observations over the period 1993-1998, doing a study in more recent times can be beneficial due to the significant changes in innovation and firms awareness that have occurred. This thesis aims to fill the gaps in the literature concerning the effect innovation has on shareholder breadth. Therefore, the research question this paper aims to answer is: **How does a firm's innovation, measured as R&D expenses, effect the breadth of shareholders, measured as the number of a firm's shareholder in the period 2018-2023?**

The current literature, firstly, aims to answer the question what effect visibility, as defined by marketing expenditures, of firms does to their stock performances and breadth of ownership, as defined as the number of investors who hold a given stock. Secondly, how investor attention influences stock prices, creating a spillover effect. Thirdly, how shareholder breadth effects a firms' performance. Research is keen on answering how a firms' awareness effects its shareholders breadth, how shareholder breadth effects a firm's performance and how innovation contributes to the financial position of companies.

Numerous contributions have already been made in the field of shareholder breadth, laying a groundwork for this papers' academic inquiry. Most research has been keen to study the effect familiarity has on shareholder breadth. For example, a study has been done on home bias by French and Poterba (1991). Who find that investors overweigh their portfolios with domestic stocks, although the benefit of international diversification have been recognized for decades (Fletcher & Marshall, 2005; Marsh & Staunton, 2002).

Another well-known studies done in this field, is by the article of Barber and Odean (2008), they show that in the US the individual investors tend to be net buyers of attention grabbing stocks, such as those heavily discussed in the news. This behaviour stems from the challenge investors face looking through many potential stocks to buy, leading them to focus on the stock that caught their attention. They conclude that attention-driven stocks do not lead to abnormal returns. Moreover, Grullon et al. (2004) find in their paper evidence that a firm's overall visibility with investors, measured by marketing advertising, has a significant effect on the stock market and breadth of ownership. Nevertheless, as Hirshleifer et al. (2013) note, these and other studies provide evidence suggesting that due to limited investor attention, prices do not fully incorporate the arrival of public information. Particularly when information appears during a period of low investor attention (e.g. Hubermann and Regev, 2001; Klibanoff, Lamont, and Wizman, 1998; DellaVigna, and Pollet, 2009; Hirshleifer, Lim and Teoh, 2009). Multiple models also predict that a lack in investor attention affects stock prices and can cause an underreaction in the market (Peng and Xiong, 2006; Hirshleifer and Teoh, 2003; Hirshleifer, Lim and Theoh, 2001).

Chen et al. (2002) point out the importance of the breadth of ownership. They explore how the breadth of ownership affects stock returns, finding that when breadth of ownership is low, prices are high relative to fundamentals.

Furthermore, a reduction in breadth is expected to forecast lower future returns, providing evidence on the importance of ownership breadth. Since Schumpeters' theory many economists have argued that resource allocation combined with technological innovation is the driver for long-term economic growth. A paper that discusses the effect innovation has on a firms' performance is research by L. Kogan et al. (2017), this research offers evidence linking innovation directly to the economic growth of a firm. L. Kogan et al. (2017) used a combination of US data on patents from 1926 to 2010 and data from the stock market. The patents provide a measure of innovation, the authors developed a model that considers the response of the stock market to patent rights. Finding that capital and labour flow away from non-innovative firms towards innovative firms within the industry.

The initial sample consists of all North American companies that have available data on the Compustat database. Because the focus of this thesis is the effect of firm's research and development expenses on breadth of ownership, as defined as the number of investors who hold a given stock, only observations that have data available (non-missing values) on research and development are included. In this thesis firms are only included that do report research and development expenses. Data on research and development expenses are obtained from Compustat, Compustat carries companies that are both active and delisted, they do so because in this way data doesn't fall victim to survivor bias. As well as data on the number of shares outstanding and the number of common shareholders. Following this research the thesis will examine if investors are more likely to buy stocks of companies with higher levels of research and development expenditures. This will be done by testing if cross-sectional patterns in a firm's innovation are related to the firm its total number of common shareholders.

This paper does not use total research and development expenditures as a measure for innovation, rather a ratio of R&D to assets. Portfolios will first be made by sampling the firms based on market capitalization (amount of shares outstanding multiplate by share price). Each market value sample is then divided into five subgroups based on R&D expenses. A multivariate regression framework to analyse the relation between research and development expenditures and number of shareholders. With ownership breadth being the dependent variable and research and development expenses as the independent variable. A variety of control variables are added to improve the model, market value is one of them, as bigger firms are more likely to have more R&D. Moreover, ROA is added as a control variable. As companies that perform better financially might be more popular for shareholders. Since this paper uses panel data, the assumption of ordinary least squares might not hold. Leading to an estimation of two types of panel data models, first to address that observations from the same firm are

not independent, a between-firm regression is done. Secondly to control for unknown form-specific factors that influence the breadth of ownership, a within firm regression is carried out.

Similar to Grullon et al. (2004) who found that firms with greater advertising expenditures, have a larger number of investors, this paper hypothesizes to find that firms with greater research and development expenditures have a larger number of investors. This anticipated result is due to the positive market perception that companies usually hold because of innovation. This reputation can make firms more attractive to investors. Moreover, companies with high R&D spending are often seen as leaders in their market and in innovation, this makes companies attractive to investors who are looking for growth opportunity. Furthermore, high R&D expenditures lead to better and more (social) media coverage, publicity and brand reputation, according to Grullon et al. (2004) also leading to a larger breadth over shareholders. Additionally, it is expected that companies with a larger number of shares outstanding will have a larger breadth of shareholders. At last it is hypothesized that the interaction effect of advertising expenses and R&D expenses is noteworthy, due to the synergy it can create. Enhancing the company's market perception and investor appeal.

This thesis finds that there is a negative relationship between R&D expenses and the breadth of shareholders. Meaning that companies with higher R&D expenses tend to have fewer shareholders. Furthermore, advertising expenses show a mixed effect on the breadth of shareholders. Although advertising generally attracts more shareholders across different firms, this is not the case for within the same firm. Within the same firm higher advertising expenses lead to a reduction in the number of shareholders. Lastly, the interaction effect between R&D expenses and advertising is negative, large investments in both might send mixed signals to investors, leading to a decrease in shareholder breadth.

These results have consequences for firms trying to grow their shareholders base. Companies need to be strategic in the way they communicate their R&D spending. A way of doing this could be by highlighting the long-term benefits of R&D investments to control for any negative perceptions. Furthermore, it is essential that companies have balanced approach to R&D and advertising.

Not only firms need to corporate this new information, also investors should be aware of this papers' results when constructing their portfolio. Investors need to be aware of the R&D expenditures of firms as it ca have negative results. Nonetheless, investors might benefit from focussing on a companies' innovative investments. Innovation still generates patents and adds significant value to the firms.

The results from this thesis emphasize the complexity of innovation investments and how the market reacts to it, highlighting that both companies and investors need to keep an eye on it when making strategic decisions.

Chapter 2 Theoretical Framework

2.1 Awareness and Home Bias

To lay down a clear framework for this theoretical schema surrounding this paper, it is crucial to start with the literature regarding the effect awareness and marketing has on firm performances and the breadth of shareholders. Starting with one of the most cited papers written on home or domestic bias in the literature. French and Poterba (1991) in their paper ''Investor Diversification and International Equity Markets'' investigate why most investors hold most of their wealth in domestic assets, even though the benefit of international diversification have been recognized for decades by Fletcher & Marshall (2005) and Marsh & Staunton (2002). They constructed a new estimate of investors in the US, Japan and Britain who hold international equity portfolios. The main findings conclude that more than 98% of the equity portfolio of Japanese investors is held domestically, subsequently, 94% for US investors and 82% for British investors. Also finding that the lack of diversification is not due to institutional constraints, but due to a result of investor choices.

Moving on to the well-known paper by Barber and Odean (2008), who test the hypothesis that individual investors are more likely to buy rather than sell stocks that caught their attention. Stock attention is measured as stocks in the news, stocks experiencing high abnormal trading volume and stocks with extreme one-day returns. Reason for their hypothesis comes down to this explanation: there are thousands of stocks that an individual investor could be interested about, but investors have limited time and resources, leading to the hypothesis that individual investors tend to buy those stock that caught their attention. The authors find evidence that individual investors are predominantly buy stocks that capture their attention, finding that attention buying effects individual investors significantly more than attention selling.

However, institutional investors do not exhibit the same bias, due to the possession of more sophisticated strategies. As highlighted in the article of Barber and Odean (2008), stocks that capture media attention tend to attract more individual investors, which aligns with the ''firm awareness effect'', where more visibility can expand a company's shareholder breadth. Grullon, Kanatas and Weston (2003) investigated this effect. The authors hypothesise that when investors buy a stock, partially due to their general familiarity with the firm, the visibility among investors will generally lead to a greater breadth of ownership of the companies' stock. The chosen measure for the visibility to be related to this investment bias is the firm's product market advertising expenditures.

Previously the authors present evidence that a firm's overall visibility with investors, as measured by its product marketing advertising expenses, has significant importance on the stock market. Grullon, Kanatas and Weston (2003) more specifically find that firms with a larger advertising expenditures,

have a greater breadth of shareholders, leading to the interesting, important spillover effect. The paper finds a new and unconventional insight on what proxies can effect in the stock market. Moreover, finding that advertising has more effect on individual investors compared to institutional investors, which is in line with ''home bias'' among investors. Home bias is defined by Huberman (2001) as the preference for the familiar. The author's conclusion on ownership supplements other studies that imply that stocks which are more familiar are more likely to be held by investors, which was found by French and Poterba, (1991), Kadlec and McConnel (1994), Foerster and Karolyi (1999) Coval and Moskowitz, Grinblatt and Keloharju (2001), Huberman (2001) and Benartzi (2001).

2.1.1 Innovation

''Innovation is the systematic practise of developing and marketing breakthrough products and services for adoption by customers'', this is the definition Mckinsey & Company (2022) give to innovation. Before moving on, it's important to explain further what innovation is and why it is significant for companies and their performance. In Mckinsey & Company's web article they find that companies that equip the essentials of innovation see a substantial experience a significant performance advantage over companies that do not harness the essentials of innovation. Finding evidence that innovation can lead to an economic profit that is 240% higher than that of other companies.

It is impossible to research innovation and not talk about the founding father of the importance innovation has of companies, Joseph Alios Schumpeter (1883-1950). Schumpeter contributed a lot to political theory and economic science, but is best known for the book he wrote in 1942 called ''Capitalism, Socialism and Democracy'', in which he shapes the theory of dynamic economic growth also known as creative destruction. Creative destruction was coined by Schumpeter when observing Henry Ford's assembly line, creative destruction is seen as the driving force of capitalism as it dismantles long-standing practices to make way for innovation. As Schumpeter (1942) explains, creative destruction is a description of dismantling established processes to give space to new and improved methods of production. Technologies such as the railroad or more recent, AI, are used often to describe the phenomenon of creative destruction. Nevertheless, creative destruction can also have unwanted consequences, temporary losses of jobs and environmental issues are no stranger to creative destruction. Schumpeter (1942) highlights the important role entrepreneurs play in innovation, as entrepreneurs are the ones that introduce new products and technologies.

53 years later Bower and Christensen (1995) wrote a revolutionary article, ''Disruptive Technologies: Catching the Wave',' on innovation. Bower and Christensen (1995) investigate one of the most consistent patterns in business: ''the failure of leading companies to stay at the top of their industries when technologies or markets change''. Explaining that established companies miss chances in new

technologies due to innovations that, at first, do not match with their customers. Finding that leading companies succumb to a management dogma: they stay to close to their current customers. Bower and Christensen find that smaller, more agile companies do use and benefit from these innovation opportunities by targeting overlooked segments, gaining momentum and disrupting market leaders. This paper highlights the importance recognizing and adapting to disruptive technologies for growth and survival of companies. As is outlined by Bower and Christensen, understanding innovation is crucial in the difference between being a market leader or becoming obsolete.

Hirshsleifer, Hsu and Li (2013) discuss how limited investor attention can lead to market underreaction to relevant investment news, this happens especially when relevant news arrives during periods of low investor interest or distraction in the market, also found by Hubermann and Regev (2001), Klibanoff, Lamont, and Wizman (1998), DellaVigna, and Pollet (2009), Hirshleifer, Lim and Teoh (2009). Prices do not fully incorporate the arrival of relevant public information. This issue is especially important when dealing with information about new technologies or innovations, where the relevance might not be plain to see or hard to analyse. Theoretical models have proven that limited investor attention affects stock prices and can cause market underreaction, which is found by Peng and Xiong (2006), Hirshleifer and Teoh (2003) Hirshleifer, Lim and Theoh (2001). These studies consider the processing of news about current performance such as earnings announcements. Hirshsleiffer, Hsu and Li (2013) argue that investors have more difficulty processing information that is less tangible, like earnings announcements and stock market news.

Giving an example about prospects of new technologies or other innovations which are harder to process for investors. Leading to the authors examining the relation between innovative efficiency, operating performance as well as stock returns. Innovative efficiency being measures as the firm's ability to generate patents and patent citations per dollar of research and development (R&D) investment. The main findings from this paper conclude that innovative efficiency significantly and positively predicts higher contemporaneous market values and a superior future operating performance and stock returns. The authors also establishes that the relationship found is connected with market mispricing due to limited investor attention. The undervaluation of innovative efficiency give opportunities for higher future returns, making innovation a dominant factor in market analysis.

Another paper delving into the undervaluation of research and development expenses, treated as an intangible asset, is by Chan et al. (2001). The authors of the paper ''The Stock Market Valuation of Research and Development Expenditures'' research if the stock market fully values research and development expenditures of firms under the US accounting standards. Along a similar line, Kogan, Papanikolaou, Seru and Stoffman (2017) propose a new measure of the private economic value of innovations based on the stock market reaction to the permitting of patents. By exploiting stock price movements, following days patents that are granted to the firms, the authors established an private value

estimate of the patents and therefore the new innovations. Kogan et al's (2017) way of measuring innovation differs from the way this thesis measures innovation. This article contributed to the growing research that investigates the connection between innovation and the dynamics of firm growth, found by Klette and Kortum (2004). The key conclusion of the paper include that technological innovations have a significant role in productivity and economic growth. Additionally, the economic value of innovations offers a robust indicator that correlates with the scientific importance of the patents. Ending with that innovation, just as Schumpeter's theory says, leads to growth and creative destruction. Thus, this study provides a quantifiable measure of the economic importance of innovation.

Hypothesis 1: Firms that spend more on research and development will have a larger number of common shareholders.

2.2 Shareholder Breadth

''It is only when the tide goes out that you learn who has been swimming naked'', this is what Warren Buffet once said, describing when market conditions are high, it will be easy for businesses and investors to look healthy. Only when economic time are less favourable, companies' weaknesses will be exposed. This metaphor illustrates the importance of shareholders keeping a close watch and accountability on a company's management, especially in times of financial uncertainty. Investopedia (2024) define shareholders as: ''A shareholder is a person, company, or institution that owns at least on share of a company's stock or in a mutual fund. Shareholders essentially own the company, which comes with certain rights and responsibilities. This type of ownership allows them to reap the benefit of a business's success.'' Additionally shareholders enjoy the right to vote at shareholders meetings, essentially playing a crucial role in a companies' governance and oversight, for example to approve of members of the board.

Nonetheless, shareholder can lose their investment in case of a bankruptcy. An example illustrating what right shareholders hold and why they are play a vital role, is that of Netflix its shareholders. Netflix its shareholders voted to reject the fruitful packages of the company's leaders, including the co-chief executives, as is stated by the The New York Times (2023). The significance that shareholders hold within companies is clear, but how do shareholders effect the firms' financial performance?

Whilst this thesis does not present a direct link between ownership breadth and a firm's value. The paper ''Breadth of ownership and stock returns'' by Joseph Chen, Harrison Hong and Jeremy Stein (2001) does investigate the effect the breadth of ownership has on stock returns. The authors developed a stock market model with opinion differences and constraints in short-sales. The hypothesis the authors test, is low shareholder breadth, when fewer long positions are held by investors, signals prices being high relative to fundamentals. Meaning that a reduction in shareholder breadth should predicts a lower return in the future. The results presented by Chen et al. (2001) include that stocks with a decrease in

shareholder breadth, compared to last quarter, tend to underperform stocks with an increase in shareholder breadth compared to last quarter.

This paper is relevant due to the fact it connect shareholder breadth on firm performance. On top of that, similar findings have been done by Benston and Hagerman (1974), Chen, Hong, and Stein (2002), whose findings include that firms may benefit in a breadth of ownership increase. In addition the paper by Amihud, Mendelson and Uno (1999) researched the effect an increase in the number of shareholders has on stocks in Japan. The study is based on Merton (1987) who suggests that an increase in a firm's investor breadth will increase the value of the firm. A broader ownership base results in more awareness, and potential interest, among investors in a firm's stocks. As was found by Amihud and Mendelson (1986). This leads to a narrower bid-ask spread, which means that this stock is highly liquid and has a great demand.

Furthermore, the shareholder breadth will also effect risk diversion. Additionally, according to Booth and Chua (1996) A firm can benefit from risk tolerance, a variance of perspectives on investments and strategic preferences, if a company has a wide range of shareholders. Potentially this wide range can lead to less variance in stock prices during fluctuations. At last, a wider shareholder base can be a strategy for companies to utilize the benefits of increased liquidity and higher stock prices as Brennan and Copeland (1988) found. The authors conclude that corporate decisions, e.g. PO's and dividend policies, are often influenced by the breadth of shareholders.

Hypothesis 2: The number of shares outstanding has positive effect on the number of common shareholders.

2.2.1 Interaction between Innovation and Advertising

Shareholders hold certain power over management, companies' managers feel the need to measure and communicate the impact of their actions on shareholder returns. As Drucker already emphasised in 1973, stating that innovation and marketing are two crucial components in a companies' financial long-term health.

The paper by Srinivasan et al. (2009) examines how product innovation and marketing investments affect stock returns. Unlike the data collection in this thesis, the authors examine the effect of innovation and marketing on shares within the industry of automobiles. The authors conclude that product innovations significantly improve stock returns. Moreover, the authors find that marketing, specifically advertising, enhances the effect product innovation has on stock returns, explained by the increase in visibility of the innovations. As explained, the paper by Srinivasan et al. (2009) highlights the interaction effect between product innovation and marketing actions. This interaction suggests the effect innovations have on financial benefits is escalated when supported by a marketing strategy. The breadth

of shareholders consists of individual investors and institutional investors, many papers have already proven that there are differences between these two investors, found by Li et al. (2017). For this paper there is no distinction between individual investors and institutional investors, as one will not influence shareholder breadth more than the other.

Furthermore, the long and short term effects of innovation and marketing on a companies' performance are worth noting. Pauwels et al. (2004) emphasise the impact of innovation and advertisement on short- and long-term stock market performance and financial health, particularly within the automobile industry. New product introductions, when entering new market segment, contribute to the firm's top-line (revenue) and bottom-line (profit) results in the long run. Unlike new product innovations, promotional and marketing only have a short term positive effect on the top-line performance. The long term financial effects are less significant when promotions and advertising is used. This paper thus concludes that innovation has long term effects for firms and advertising has short term effects, giving this thesis another reason to study the effect innovation has on shareholder breadth.

Hypothesis 3: There is a positive interaction effect between advertising expenses and research and development expenses in firms.

Chapter 3 Data

3.1 Data collection

This thesis uses data collected from Compustat. Compustat has data from 1950 and onwards and is published by Standard and Poor's since 1962, it is a popular database provider of financial market information. Both active and non-active companies and industries are included in the database, this is due to ''survivor bias''. Furthermore, Compustat has included over 55.000 businesses over the whole world divided into two groups, Compustat North America and Compustat Global. Compustat North America is used in this thesis. According to Compustat, 'North America' includes ''U.S. and Canadian fundamental and market information on active and inactive publicly held companies''.

This research utilizes data from Compustat North America. The data is collected from the years 2018-2023, which are the most recent, complete five years. The data from Compustat is collected through WRDS (Wharton Research Data Services). The chosen data is from the first of December 2018 till December 2023. As this paper is looking at how innovation affect the firms' shareholders breadth, the whole database population is selected as sample. As well as active and non-active businesses are chosen to include in the sample, as to prevent survivorship bias. Subsequently, the correct variables are selected to be included and lastly the data output will be in a STATA file.

Since the focus of this thesis is how a firm's innovation, measured as R&D expenses, effect the breadth of shareholders, measured as the number of a firm's shareholder, observations are only included in the final sample that have available data (non-missing values) on research and development expenses. Equally for the other variables, the other variables are only included in the final sample when there is available data on them. Excluding the firms that have missing values vastly reduces the final sample size. Grullon et al (2003) stated in their paper that it is not possible to distinguish between companies that do not report their research and development expenditures and companies that have a research and development expenditures equal to zero. Thus, in their analysis they only included the firms that have reported R&D expenses bigger than zero.

This thesis in the contrary does include firms that report R&D expenses equal to zero, as it possible that firms do not have or need a R&D department and therefore have zero expenses in this regard. Furthermore, this paper uses a relative/scaled measure of research and development expenses. The scaled measure of research and development expenses is a ratio of the absolute R&D and the total assets of the firm. Whereas Grullon et al. (2003) used the absolute value for their main independent variable advertising expenses.

3.2 Summary Statistics

In this part of the paper a multivariate framework will be analysed to investigate the relationship between research and development expenses and the number of shareholders. The dependent variable in the model is the number of shareholders, and the independent variable is research and development expenses. Control variable are added to control for any confounding effects. Firstly, market value is added into the model as a control variable duo to larger firms creating more awareness of their firms and because they might have more shares to buy. Therefore market value is added to control for size effects. Secondly, return on assets is incorporated into the model as a control variable as investors are more likely to be attracted to firms that are financially healthy. Return on assets will be calculated in the final sample as a firm's net income divided by the firm's average total assets. Furthermore, common shares outstanding is added, as it might influence the shareholder breadth. Furthermore, log transformations are used in the model to reduce the impact skewness and outliers might have on the control variables.

Table 1: Comparison of the sample firms with firms with missing values for R&D expenses missing

Comparison of the sample with firms with missing values for R&D expenses	Final Sample Firms			Firms with missing value for R&D expenses		
	Mean	**Median**	**No. of observations**	**Mean**	**Median**	**No. of observations**
Firm characteristics						
Scaled R&D expenses	0,10	0,036	5.770	-	-	-
Advertising expenses (in million $)	140,52	8,10	5.770	148,72	10.54	2.800
Market value (in million $)	15.306,99	1.241,50	5.770	10.238,94	1.021,31	2.800
Common shares outstanding (1.000.000s)	464,28	58,78	5.770	556,89	56,01	2.800
ROA	-0,86	0,00	5.770	-0.64	0,01	2.800
Active			5.186			2.558
Inactive			584			242
Breadth of ownership						
Number of shareholders (1000s)	8,07	0,20	5.770	12,39	0,37	2.800
Total number of observations			5.770			2.800

Table 2: The effect of innovation on the breadth of ownership: regression analysis

Sample description	Mean	Std. Dev.	5th percentile	Median	95th percentile	No. of observations
Firm characteristics						
Scaled R&D expenses	0,10	0,45	0	0,04	0,30	5.770
Advertising expenses (in million $)	140,52	675,00	0,066	8,10	637	5.770
Market value (in million $)	15.306,99	90.677,71	11,60	1241,50	50.223,33	5.770
Common shares outstanding (1.000.000s)	464,28	11.309,85	7,06	58,78	683,20	5.770
ROA	-0,86	27,15	-0,88	0,00	0,18	5.770
Active						5.186
Inactive						584
Breadth of ownership						
Number of shareholders (1000s)	8,07	44,94	0,011	0,197	30,01	5.770
Total number of observations						5.770

Description: this table reports summary statistics for the sample firms. The included firms have the must obey the following criteria: The companies' financial data are available on Compustat – Capital IQ; firms must have available (non-missing values) data on research and development expenses, advertising expenses, market value, common shares outstanding, company status and the number of shareholders. Outliers, due to input mistakes in Compustat, have been removed. Research and development expenses, advertising expenses, market value, common shares outstanding, company status and the number of shareholders are collected from Compustat.

Table 3: The effect of innovation on the breadth of ownership: univariate analysis

			Market value quintile		
Innovation quintile	**Smallest**	**2**	**3**	**4**	**Largest**
Number of common shareholders (in 1000's)					
Smallest	1,93	2,30	6,02	8,83	42,15
2	0,81	1,83	3,33	13,42	50,75
3	0,70	1,81	1,85	4,66	21,64
4	1,12	1,34	1,34	1,06	12,29
Largest	1,01	1,20	0,60	2,04	17,67
Difference (largest – smallest)	-0,92	-1,10	-5,42	-6,79	-24,48

Description: table 3 shows the comparison of equally weighted portfolio means for different measures of breadth of ownership by quintile of market value and scaled research and development expenses. The averages in the table are equally weighted portfolio means of the number of shareholders. The innovation quintile is scaled R&D expenses derived from the ration for total R&D expenses and total assets. These portfolios are made as follows, first the final sample is divided into five quintiles based on their market value. Afterwards each market value quintile is then divided into five quintiles based on the scaled research and development expenses. The averages are based on equally weighted cross-sectional means. The market value, research and development expenses, total assets and the number of common shareholders are subtracted from the Compustat-IQ data base.

3.3 Preparing Final Sample

Table 1 shows a comparison the this paper's final sample with the firms that that have missing values the independent variable research and development expenses. It is apparent that the firms in the final sample roughly have the same advertising expenses, market value, common shares outstanding and the number of common shareholders. In conclusion, table 1 depicts that, although, this thesis only includes firms that have available data on research and development expenses, the final sample of firms is still a unbiased sample from the North American population of Compustat firms.

Table 2 offers the descriptive statistics of this papers final sample. For each variable chosen for the model the mean, standard deviation, 5th percentile, median, 95th percentile and the number observations are noted. When having a closer look at the descriptive statistics it becomes clear that the final sample of firms contains a wide range of characteristics. For example the 5th percentile of the scaled measure of R&D expenses is 0, the median 0,04 and the 95th percentile is 0,3. Showing that there is a big range between the median and 95th percentile. Amazon.com Inc has the highest R&D expenses out of all the companies in the final sample, spending over 85,62 billion US dollars in 2023.

A similar conclusion can be made about the advertising expenses in the sample, this variable also has a wide range of values, and again, Amazon.com Inc being the biggest spender in this area with 20,60 billion US dollars in 2022. The market value median of the firms in the sample is 1,24 billion US dollars, however this time it's Bill Gates his company, Microsoft Corp, with the highest value in this papers sample. Whilst looking at a scatterplot of the companies' common shareholders something peculiar came up. Some firms in the sample had an abnormal high number of shareholders, this was due to input errors by the firms or Compustat. By a simple calculation it became apparent that some companies did not account for the time 1000 factor of the number of shareholders. These companies have been dropped to get a more reliable final sample. After dropping these outliers the mean of the common shareholders dropped from 148.950 to 8,07 common shareholders. and for the standard deviation a similar significant drop was observed. After dropping the outliers the final sample contains 5.770 observations, with 89,87% active companies and 10,13% inactive companies. After comparing the means and medians of the variables, the conclusion can be made that the usual left-skewness is found in the database. Thus this thesis will use log-transformations for advertising expenses, research and development expenses and market value.

Chapter 4 Method

4.1 Method overview

This section of the thesis will examine the question how a firm's innovation effects the breadth of shareholders in the period 2018-2023. This is done by researching if cross-sectional patterns in a firms innovation are related to the firm's total number of common shareholders. For this paper it is important to take into account that within the final sample there are big differences in firm sizes, therefore this paper will control for firm size. The final sample has a big range in market value, with the 5th percentile being 11,60 million US dollars and the 95th percentile nearing 51 billion US dollars

Table 3 exhibits a portfolio analysis of the relationship between innovation and the breadth of ownership similar to the portfolio analysis done by Grullon et al. (2003). At the start, the portfolios are formed by dividing the final sample into quantiles based on market value. Additionally, each market value quintile is divided into five subgroups based on research and development expenses. Each cell in table 3 shows the equally weighted portfolio mean of the number of common shareholders. Table 3 analyses if the breadth of ownership increases with advertising after controlling for firm size. Each value in table 3 entails the equally weighted portfolio mean of the number of shareholders. The table shows that the larger the scaled R&D expenses, controlled for size, the smaller the number of common shareholders. What stands out is that the average number of shareholders in the largest scaled R&D quintile is always smaller than in the smallest quintile. The smallest market value quintile indicates that the difference of the number of common shareholders between the firms in the largest and smallest scaled R&D expenses quintiles is 920. Whereas, for the largest market value quintile the difference is higher, 24.480. Arriving to the conclusion that table 3 shows that the average number of common shareholders is negatively related to firms' scaled R&D expenses, when controlling for firm size.

4.2 Regression setup

In this subsection the papers' regression analysis will be discussed. More precisely, a multivariate regression between R&D expenses and the breadth of shareholders will be analysed. Unlike the regression analysis performed on Kogan et al.'s (2017) paper, where the authors measured the private economic values of innovation based on the stock market reaction to the permitting of patents, this thesis will focus on the regression analysis similar to Grullon et al.'s (2003), as permitting patents are not embedded in the scope of this thesis.

Moreover, a variety of control variables are used, for example market value is used to control for firm size, since larger firms are more likely to have wider breadth of shareholders than smaller firms, as they might have more shares to buy. Moreover, return on assets (ROA) is incorporated as a control variable as investors might be more interested in to firms that are financially healthier. Furthermore, to reduce the impact of outliers and skewness in the control variables, this thesis uses log-transformations for all continuous variables. Log-transformations are also taken from the scaled variable R&D expenses as a log-transformation would make the variables more normally distributed and stabilize the variance.

The utilized dataset was drawn from panel data. Panel data, contains more information, variability and efficiency for assessing a long term relationships relative to pure time-series data as well as cross sectional. Therefore, panel data is useful when the data involves both time-series and cross-sectional data, providing a view of changes among entities over time and better insights. The regression

coefficients will be assessed on a 5% significance level. The following fixed effects panel regression is run in STATA:

Log_cshr i,t =$\propto$ +β1Log_Rel_xrd i,t+β2Log_xad i,t+β3Log_csho i,t + β4Log_mkvalt i,t + β5ROA i,t + μi + εi,t

Where:

- Cshr is the number of shareholder
- Rel_xrd is the scaled measure of R&D expenses
- Xad the advertising expenses
- Csho is the number of common shares outstanding
- Mkvalt is the market value of individual firms
- ROA is the return on asset of individual firms

The interpretation of the marginal effects of the regression is as follows. For example, a 1% increase in R&D expenses (Log_Rel) leads to a 1% increase of the number of shareholder (Log_cshr).

The OLS assumptions are likely to be violated, due to the pooled cross-sectional time-series data in the estimations. Therefore two different types of panel data models are estimated to address OLS violations. First of all, a ''between-firm'' regression is run to address the problem that observations from the same firm may not be independent. The ''between-firm'' regression will estimate the intrafirm means of dependent variable to the intrafirm means of the independent variables. Second of all, a ''within-firm'' regression will be performed to control for unknown firm-specific factors that might influence the breadth of ownership. Therefore the ''within-firm'' regression include firm fixed effects.

An interaction effect takes place when the effect of one variable depends on the effect of the other variable its value. The independent variable in the model might interact with another independent variable, this is the interaction effect and it indicates that a third variable effects the relationship between the dependent variable and independent variable. It is of interest to delve deeper into the interaction that advertising expenses and research and development expenses have on the breadth of shareholders.

4.3 Interpretation table 3

Table 3 exhibits a portfolio analysis of the relationship between innovation and the breadth of ownership similar to the portfolio analysis done by Grullon et al. (2003). At the start, the portfolios are formed by dividing the final sample into quantiles based on market value. Additionally, each market value quintile is divided into five subgroups based on research and development expenses. Each cell in table 3 shows the equally weighted portfolio mean of the number of common shareholders. Table 3 analyses if the breadth of ownership increases with advertising after controlling for firm size. Each value in table 3

entails the equally weighted portfolio mean of the number of shareholders. The table shows that the larger the scaled R&D expenses, controlled for size, the smaller the number of common shareholders. What stands out is that the average number of shareholders in the largest scaled R&D quintile is always smaller than in the smallest quintile. The smallest market value quintile indicates that the difference of the number of common shareholders between the firms in the largest and smallest scaled R&D expenses quintiles is 920. Whereas, for the largest market value quintile the difference is higher, 24.480. Arriving to the conclusion that table 3 shows that the average number of common shareholders is negatively related to firms' scaled R&D expenses, when controlling for firm size.

Chapter 5 Results and Discussion

5.1 Results

Table 4: The effect of research and development expenses on the breadth of ownership: regression analysis.

Dependent variable	Between-firm estimates	Within-firm estimates
Log(R&D)	-0,268***	-0,041
	(0,039)	(0,026)
Log(advertising)	0,099***	-0,033*
	(0,032)	(0,019)
Log(common shares outstanding)	0,334***	0,150***
	(0,057)	(0,029)
Log(market value)	-0,029	-0,008
	(0,038)	(0,019)
ROA	-0.011***	0,000
	(0,004)	(0,000)
N	4558	4558
Adjusted R^2	0,120	0,147

Description: Table 4 shows the estimates of the panel regression relating shareholder breadth to innovation and other control variables. Research and development expenses, advertising expenses, the number of common shares outstanding, market value and ROA are collected from Compustat. Research and development expenses is constructed as the ratio of the firms' assets and its absolute R&D value. ROA is constructed as net income divided by total assets. The standard errors are reported in parentheses below coefficient estimates. ***/**/* Significantly different from zero at the 1%, 5% and 10% level, respectively.

Table 5: Interaction effect between R&D and advertising on the breadth of shareholders.

Log(number of common shareholders)

Dependent variable	Between-firm estimates	Within-firm estimates
Log(R&D)	-0,156***	-0,045*
	(0,025)	(0,025)
Log(advertising)	-0,064***	0,003
	(0,023)	(0,029)
Log(R&D) x Log(advertising)	-0,088***	0,010
	(0,007)	(0,008)
N	4.577	4.577
Adjusted R^2	0,1411	0,042

Description: Table 4 shows the estimates of the panel regression relating shareholder breadth to innovation and other control variables. Research and development expenses, advertising expenses, the number of common shares outstanding, market value and ROA are collected from Compustat. Research and development expenses is constructed as the ratio of the firms' assets and its absolute R&D value. ROA is constructed as net income divided by total assets. The standard errors are reported in parentheses below coefficient estimates. ***/**/* Significantly different from zero at the 1%, 5% and 10% level, respectively.

Table 6: Industry Robustness Check

Dependent variable	
Log(R&D)	-0,130***
	(0,027)
Log(advertising)	0,117***
	(0,018)
Log(common shares outstanding)	0,386***
	(0,023)
Log(market value)	-0,031
	(0,020)
ROA	-0,003
	(0,002)
Sic_1623	4,609***
	(1,426)
Sic_2011	5,854***
	(1,106)
Sic_2033	7,758***
	(1,253)
Sic_2430	-2,233***
	(1,105)
N	4.558
Adjusted R^2	0,333

Description: Table 4 shows the estimates of the panel regression relating shareholder breadth to innovation and other control variables, including an industry robustness check. Research and development expenses, advertising expenses, the number of common shares outstanding, market value, ROA and the industries are collected from Compustat. Research and development expenses is constructed as the ratio of the firms' assets and its absolute R&D value. ROA is constructed as net income divided by total assets. This table only depicts four out of the 242 industries included in the robustness check, due to space limitations. The standard errors are reported in parentheses below coefficient estimates. ***/**/* Significantly different from zero at the 1%, 5% and 10% level, respectively.

Table 4 shows the effect the variables have on the number of common shareholders. The results are as followed:

- 1% increase in the spending of R&D expenses leads to a 0,268% decrease in the number of common shareholders in the between-firm estimates.
- 1% increase in the spending of advertising expenses leads to a 0,099% increase in the number of common shareholders in the between-firm estimates.
- 1% increase in the number of common shares outstanding leads to a 0,334% increase in the number of common shareholders in the between-firm estimates.
- 1% increase in the ROA leads to a 0.011% decrease in the number of common shareholders in the between-firm estimates.
- 1% increase in the number of common shares outstanding leads to a 0,150% increase in the number of common shareholders in the within-firm estimates.

Table 5 shows the interaction effect between R&D and advertising on the breadth of shareholders. The results of this table stand out due to the negative effect advertising has now on the number of common shareholders. Furthermore, the interaction effect between R&D expenses and advertising is negative. A 1% increase in R&D budget leads to a 0,088% decrease in the advertising expenses.

Something that stands out in these results is that the within-firm estimates have few results that are significant.

Lastly table 6 depicts the robustness check, where R&D expenses, advertising expenses and common shares outstanding have similar results to table 4. For example, if the industry Meat Packing Plants (sic_2011) increases by one unit, it leads leads to a 5,854% increase in the breadth of shareholders. Table 6 will be discussed more in dept in section 5.3.

5.2 Discussion

Table 4 shows results consistent with table 3, where also a negative relation is found between research and development expenses and the number of common shareholders. Furthermore, the results are also economically significant. Table 4 suggests that a 1% increase in the scaled research and development variable, the number of common shareholders decreases with 0,268%, independent of the firm's size. Leading to the rejection of hypothesis 1.

ROA has a significant, negative effect on the breadth of ownership, similar to the findings of Grullon et al. (2003). While this might seem counterintuitive, it seems to fit with the ''disposition effect'' where investor tend to hold past losers and sell past winners. However, unlike the findings by Grullon et al. (2003), table 5 depicts that advertising expenses has a negative effect on shareholder breadth when regressed with only R&D and advertising as variables. There could be a discrepancy between Grullon et al.'s (2003) paper and this one due to some difference in control variables chosen. This paper also includes a scaled R&D variable, whereas Grullon et al. (2003) did not use scaled variables in general.

Moreover, table 4 does have similar findings of advertising in the between-firm estimates as the paper by Grullon et al. (2003). But not for the within-firm estimates, which suggests that variations within

the same firm over time, higher expenditures in advertising are associated with a reduction in shareholder breadth. This, again, could be due to this paper including a R&D variable which might influence the advertising coefficient differently.

Moreover, hypothesis 2 is not rejected as evidence is found that the number of common shares outstanding have a positive and significant effect the number of common shareholders, for both the between and within estimates. Lastly, the interaction effect between the scaled measure of research and development expenses and advertising is expenses is negative, when the R&D budget raises with 1%, advertising expenses decreases by 0,088%. Leading to the conclusion that hypothesis 3 is rejected.

Both table 4 and 5 depict a low value for the adjusted R^2, meaning that the model does not the variability of the dependent variable well. As well low significance values for the market value and the interaction effect between R&D and advertising.

5.3 Robustness check

Additionally a robustness check has been conducted to asses the impact of various industries on shareholder breadth, using the Standard Industry Classification Code. This particular measurements are presented in Table 6. In total 242 industries have been analysed, however, only the most prominent industries are illustrated in the table. The robustness check reveals that firms that operate in the ''Canned, Fruits, Veg, Preserves, Jams & Jellies'' (Sic_2033) showed the highest coefficient. This indicates that this industry has a significant, and a high positive effect on shareholder breadth. The same results have been found for the industries ''Meat Packing Plants'' (Sic_2011) and ''Water, Sewer, Pipeline, Comm & Power Line Construction''(Sic_1623).

Nonetheless, the opposite can also be found, specific industries that have a significant and negative effect on the shareholder breadth. For example the robustness regression analysis revealed that the industry ''Millwood, Veneer, Plywood, & Structural Wood Members'' (Sic_2430) shows a significant negative effect on shareholder breadth. This negative relationship suggests that higher R&D expenses in this industry lead to a decrease in the number of shareholders.

5.4 Limitations

One of the limitations in this thesis lies in the exclusion of the firms in the final sample with missing data on research and development expenses, this could lead to selection bias. This thesis states that the final sample is unbiased, when compared to the population of North American firms. Although this assumption might not hold when the excluded firms systematically differ in from those that are included. Furthermore, the reliance on solely collecting data from Compustat is a limitation. Compustat could

contain more input errors and inconsistencies, as was noted with the abnormal number of common shareholders.

Additionally, the models show a low adjusted R^2 values which indicates that the explanatory variables do not explain the variability in the dependent variable fully. Further research should include other relevant factors that are missing from the analysis. The robustness and generalisation can be affected by this limitation.

Chapter 6 Conclusion

This paper aimed to investigate the relationship between a firm's innovation, measured as research and development expenses (R&D), and the breadth of shareholders. Using the Compustat data set spanning from 2018 and 2023, a within-firm and between-firm regression model is employed to answer the research question: How does a firm's innovation, measured as R&D expenses, effect the breadth of shareholders, measured as the number of a firm's shareholder in the period 2018-2023?

To answer this research question 4558 observations where investigated, revealing a negative relationship between R&D expenses and the shareholder breadth, suggesting that more R&D expenditures within firms lead to a decrease in the number of shareholders. This is in contrast with this paper's initial hypothesis and shines a light on complexity of innovation and shareholder breadth. The within-firm analysis supports these results, which indicates that the negative impact of R&D on shareholder breadth is consistent over time within the individual companies. In contrast, advertising expenses depict a positive influence on the number of shareholders in the between-firm estimates, but
a negative effect in the within-firm estimates. This suggests that advertising can attract more shareholders across different firms, the effect might reverse when focussing on the variations within the same company over time.

Furthermore, the interaction effect between advertising and R&D expenses has a negative coefficient, indicating that the combined effect of these two variables can lead to a decrease in shareholder breadth. Suggesting that large investments in R&D and advertising can send mixed signals, leading to investor scepticism.

These findings contribute to a wider understanding of how firm's strategic investments impact the breadth of shareholders. Future research could explore additional variables and use different measure of innovation, advertising and shareholder breadth to further explore these relationships.

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