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# The ESG-Risk Relationship

A study of the relationship between ESG and firm-specific risk of publicly traded firms in Sweden

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# Abstract

Non-financial metrics have come to play a larger role in financial markets as years pass, impacting decisions made by businesses, investors and policy makers alike. A significant non-financial metric captured by the term ESG or Environmental, Social and Governance. The purpose of this thesis is to investigate how ESG relates to risk at a firm-specific level. More specifically, we analyze this relationship from a market perspective using publicly traded companies in Sweden, ranging between the time period 2009-2019.

To study the relationship between ESG and firm-specific risk, we use a two-step approach which utilizes a Fama-French three-factor model to estimate the idiosyncratic volatility followed by panel data regressions. We run the regressions on idiosyncratic volatility using aggregated ESG and its individual pillars as explanatory variables while controlling for leverage, size, ROA and P/B as well as year dummies.

The results in the thesis indicate that there is a negative relationship between ESG and idiosyncratic volatility, both on the aggregated level and on individual pillars. However, this can only be statistically proven on the aggregate level on a 10% confidence level. Due to the high correlation amongst the ESG pillars we fit three specifications with the pillars on an individual basis. However, these regressions lead to the same conclusion reached earlier, namely a negative but insignificant relationship.

**Keywords**: Idiosyncratic Volatility, ESG, Fama-French three-factor model, ESG-risk relationship

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# 1 Introduction

In today's ever changing world, non-financial metrics are becoming a more significant aspect compared to previous decades for various stakeholders, playing a role in scenarios such as government regulation, allocation decisions, investor preferences and business decisions etc. There are a lot of reasons as to why this would be the case, consumer preferences have changed dramatically and the demand for e.g. the social responsibility of firms and asset managers have increased immensely. In recent years, ESG (Environmental, Social and Governance) and everything it entails has become a well discussed topic and a lot of research on its effects in various fields has been conducted by well renowned researchers, see e.g. Dorfleitner & Halbritter (2015), Friede, Busch, & Bassen (2015) and Statman & Glushkov (2009). ESG is paramount for firms and investors alike and failure to acknowledge the significance in day-to-day activities could potentially lead to detrimental long-term effects.

The aim of this thesis is to investigate the relationship between ESG performance and firm-specific risk measured as idiosyncratic volatility. In more detail, this study will analyze to what extent ESG and its individual pillars influence firm-specific risk of publicly traded firms in Sweden. There are multiple channels through which ESG parameters influence the risk of individual firms. For example if firms fail to acknowledge ESG, they are exposed to future changes in legislation and risk severe reputational damage (Karwowski & Raulinajtys-Grzybek, 2021). Implementing sustainable technologies and a responsible supply chain limits downside business risk, especially in the long-term. To our knowledge, the research and conclusions surrounding this specific topic is limited and inconclusive. However there is extensive research in related topics. Reber, Gold & Gold (2021) finds that firms that disclose their ESG work in relation to an IPO exhibits lower idiosyncratic risk. Furthermore, Sassen, Kinze & Hardeck (2016) analyze how ESG is linked to market-based risk in Europe, and find a negative relationship between social performance and systemic-, idiosyncratic- and total risk, while governance performance proved insignificant. The authors further find that environmental performance mainly decreases idiosyncratic risk, while effects on total and systemic risk are solely experienced in environmentally sensitive industries. We believe that this thesis will contribute by shining further light on the ESG-risk relationship by analyzing the aggregated ESG, the deconstructed ESG, and potential differentiating effects amongst them. We make use of

ESG-ratings from Sustainalytics which previous literature has not considered. Moreover we solely focus on a market- and firm-specific risk measure, i.e. idiosyncratic risk.

By utilizing the three main ESG components, environmental, social and governance, we are able to make a more thorough and deep diving analysis of its effects on firm-specific risk. The three individual pillars are different from each other and thus, intuitively, affect risks to a differing extent. For example there are direct and indirect costs associated with the environmental pillar. Direct costs include rising sea levels while indirect costs can be consumers choosing more environmentally friendly products. Socially responsible firms have lower risk of suffering reputational damage, etc. This is further elaborated on in later chapters. However, even though they are different from each other, all pillars are individually important for a firm, and how they are able to manage potential changes in future regulation, and times of distress (El Khoury, Nasrallah, Harb & Hussainey, 2022). The importance of each pillar could also change depending on the specific company and industry.

To investigate and find answers to our hypothesis we have our foundation in a two-step approach utilizing the Fama-French three-factor model to estimate idiosyncratic volatility and panel data regression models to calculate the influence of ESG on idiosyncratic volatility (Fama & French, 1993). The former model uses the traditional factors, namely: market excess return, size factor and value factor (Fama & French, 1993). In the panel data regression models, we use idiosyncratic volatility as a dependent variable, ESG as explanatory variable, with the addition of control variables (leverage, size, ROA, and P/B) and dummy variables for each year (Sassen, Hinze & Hardeck, 2016). Some of the main advantages with this approach is its relative simplicity, but it still manages to give intuitive and economically relevant results while being easily interpretable. Because of its simplicity, it allows for easy modifications giving the user the possibility of further extensions in terms of control variables, etc.

The results of the analysis show a consistent negative relationship between ESG and idiosyncratic volatility. The aggregated ESG-score is significant at a 10% confidence level while the result for individual pillars are insignificant. In other words, firms with higher ESG ratings tend to have lower risk as perceived by the market. These results of a negative relationship are coherent with some relevant previous research, see for example Reber, Gold & Gold (2021), Cerqueti, Ciciretti, Daló & Nicolosi (2021) and Friede, Busch & Bassen (2015). Even though the

results for the individual pillars are insignificant, our regression indicates that the environmental pillar is the most important factor, followed by the social pillar and lastly the governance pillar.

We believe that, in these changing times, a greater understanding of the relationship between company risk and ESG is becoming increasingly important for each passing year. By analyzing the three individual pillars of ESG, instead of solely one parameter, it will bring further depth and insight into potential drivers for company risk. For retail investors, a greater understanding of this relationship could serve as a tool for long term investing and risk minimization depending on the assigned ESG rating, by exploiting potential differences between the ESG pillars.

The remainder of this paper is organized as follows: In chapter 2, we discuss and analyze previous research relating to our research topic, different available approaches, and weigh them against each other to find the most suitable for this paper. In chapter 3 we present the research framework, the hypotheses development, and additional essential factors required to answer these. Chapter 4 investigates and analyzes the data as well as presents its characteristics. The following chapter, 5, presents our method of choice, how we implement it with our data set, and formulate our hypotheses for our thesis. In chapter 6 we discuss our findings, present the results of our analysis and how it answers the hypotheses. Additionally, this chapter will briefly discuss how further research on this topic can be improved. Finally, chapter 7 concludes our findings and we present some final comments.

# 2 Previous Research

Extensive research has been conducted on the relationship between ESG and the stock market. Previous literature has covered topics relating ESG to corporate financial performance (CFP), both on an individual firm-level as well as on a larger market-level. This chapter aims to untangle the relationship between ESG, returns and risk in order to clarify and highlight the economic relevance as well as the purpose of this thesis.

## 2.1 ESG and CSR

The definition of ESG and CSR is diffuse and may differ in the eyes of academia, investors and corporations. Moreover, the type of behavior and policies that is defined as ESG is vague and up for debate since there is no agreed upon universal framework for what constitutes ESG. In light of this, we present a definition based on previous research and a general consensus amongst the industry. ESG is an acronym for three categories, Environmental, Social and Governance. It is a broad term that establishes a framework to assess to what extent a corporation is working towards social goals that goes beyond maximizing shareholder value (Qin, Qiang, Asif, & Yunfeng, 2022). Moreover it is closely related to the term CSR, or Corporate Social Responsibility. CSR captures the first two elements, namely the environmental and social impact of the firm (Gerard, 2019). The two terms, however ambiguous they are, are important in the context of financial markets. In a seminal paper by Geoffrey Heal named “Corporate Social Responsibility: An Economic and Financial Framework” (Heal, 2005), Heal (2005) tries to establish a link between CSR and the financial markets. The author defines CSR as a programme of actions taken by firms in order to reduce externalized costs or to avoid distributional conflicts. The role of CSR stems from market failure in which private- and social costs are not in symbiosis. Furthermore, Heal (2005) determines that in some sectors the private- and social costs are more in line and CSR is needed to a lesser extent, but these sectors are dominated by others where the opposite is true. Finally, Heal (2005) concludes that for firms, a CSR programme can be a beneficial component of corporate strategy by reducing risks and helping maintain long-term relationships that boosts long-term profitability. In a seminal meta-analysis of ESG and CFP, Friede, Busch & Bassen (2015) finds a strong and consistent positive link between ESG performance and financial performance. The paper aggregates over 2000 studies and finds

that almost 90% of studies find a non-negative relationship with the majority of them being positive.

Now, we turn our attention to the individual components of ESG and try to examine how they impact financial performance at a firm-specific level. In an attempt to establish the link between adopting high environmental standards and firm value Dowell, Hart and Young (2000) finds that corporations that adopt a single strict global environment standard, in comparison to U.S. statutory standards or poorly enforced host country standards, have higher market values. Golicic and Smith (2013) analyze environmentally beneficial supply chain practices and find a positive link between environmentally based supply chain practices and firm performance, specifically that there is a significant and positive relationship with different types of performance measures such as market-based, operational-based and accounting-based.

Economic arguments that lay the foundation of a positive link between social performance and financial performance can be deduced into the "good company" and the "good management" hypothesis (Gerard, 2019). The "good company" hypothesis states that building good relationships with key stakeholders by taking their social interests into account through CSR work gives rise to reputational gains and thus increases the valuation of the firm through reducing exposure to negative events and increased profitability. The second hypothesis lays its emphasis on the firms management, suggesting that due to the difficulty in implementing "socially effective" policies, managers that successfully do so can be deemed skilled, which translates to higher firm value through more effective use of assets and higher profitability. Miller, Eden, & Li (2020) results ties into "the good company" approach, they find that reputational gains with regards to CSR translates to higher profits by investigating banks in the United States. More specifically they find that for the average bank with $1 billion in assets gaining a positive CSR reputation translates to a rise in profits of 4.04%.

The link between corporate governance and firm performance is established and intuitive, both when considering operating- and market based performance measures. Bhagat & Bolton (2008) investigate the relationship between corporate governance and firm performance. The authors find that better governance, as measured by stock-ownership of board members and CEO-Chair separation, is significantly positively correlated with operating performance. Gompers, Ishii and Metrick (2003) finds that the risk-adjusted returns of firms with strong shareholder rights are

notably higher than firms with weak shareholder rights. Thus, the link between governance and firm performance is clear, better and more fair management of the firm tends to increase profitability, both when considering operating measures and market based measures.

## 2.2 ESG and Returns

There are several studies which analyze the relationship between different companies' social performance (measured via ESG ratings) and their financial performance, where many find varying conclusions between these. To this, many studies further analyze the individual effects of environmental, social, and governance. Some of the oldest research within ESG are papers that compare conventional funds and socially responsible investment (SRI) funds, for example Statman (2000), Bello (2005), and Hamilton, Jo & Statman (1993).

In a more recent study by Halbritter & Dorfleitner (2015), the authors analyze if there exists any relationship between a company's ESG rating and their financial performance in the United States between 1992 and 2012. To conduct this study, they make use of a Carhart four-factor model as well as a Fama and MacBeth approach with ESG portfolios. As opposed to previous literature, they do not find a significant difference between companies with high and low ratings and their financial performance. However, the Fama and MacBeth regression did indicate significant influence of some ESG variables.

In another, arguably more narrow, study by Derwall, Guenster, Bauer & Koedijk (2005), they analyze the impact of ecological responsibility on different companies' returns. Similar to Halbritter & Dorfleitner (2015), they study U.S companies within the timeframe of 1997 to 2003, by using a high-low portfolio strategy with the Carhart four-factor model. In comparison to the previously mentioned study, Derwall et. al. (2005) find significant performance of highly rated companies over low rated.

More recently, Lee, Faff & Rekker (2013) investigates the financial performance dependence on overall ESG rating in the U.S between 1998 to 2007. In coherence with previous literature, the authors use a Carhart four factor model which yielded results of high rated companies significantly outperforming low rated.

To summarize, the findings of previous literature is coherent to some extent, the evidence points to a positive relationship between ESG and returns on the market. For additional research on the relationship see e.g. Eccles, Ioannou, & Serafeim (2014), Kempf & Osthoff (2007), Galema, Plantinga, & Scholtens (2008), Manescu (2011) and Statman & Glushkov (2009).

## 2.3 ESG and Risk

Performance of firms can be measured in a multitude of ways, one of these forms, i.e. risk performance is important as it is linked directly to the predictability and endurance of company success (Orlitzky & Benjamin, 2001). As outlined above, in the recent decades ESG has been occurring increasingly within financial markets, both in academia but also amongst industry professionals. However, with rewards comes risk and the debate if the ESG factor is able to convey information regarding company specific risk still persists. Currently, there exists arguments both in favor of and against ESG rating having a significant influence on a company's riskiness.

Risk at a firm-specific level can be separated into two parts: the fluctuations of financial performance over time with regards to share prices, i.e. market risk, and accounting based measures, i.e. accounting risk (Orlitzky & Benjamin, 2001). Risk can, generally speaking, be explained as the potential of losing firm value as a result of uncertainty concerning future events and outcomes (Chang, Kim & Li, 2014). Financial theory further divides market risk into idiosyncratic risk and systematic risk (Jo & Na, 2012). The systematic risk captures the firm's sensitivity to market movements, for example excess market returns in the CAPM-model, while the idiosyncratic part is firm-specific.

In comparison to research on ESG and returns, research on ESG and risk are somewhat more limited. In a study by Goss & Roberts (2011), the authors relate how corporate social responsibility affects bank debt in the US. Thus, analyzing the CSR-risk relationship from a new viewpoint compared to previous literature. From a sample of 3996 company loans, the authors found that companies with good CSR work usually pays betweens 7 and 18 basis points lower than companies with concerns about their CSR work. This result gives an indication that, from the viewpoint of banks as delegated monitors, good and efficient CSR work is seen as risk-reducing.

In another study by Reber, Gold & Gold (2021), the authors analyze how ESG disclosure relates to idiosyncratic risk in initial public offerings. The authors further state that ESG disclosure can mitigate idiosyncratic risks, with the arguments foundations in legitimacy theory. When analyzing data on U.S. companies between 2002 and 2018, Reber, Gold & Gold (2021) finds that voluntary ESG disclosure does result in a positive impact on idiosyncratic risk and downside tail risk. To this, the authors can establish a relationship of higher ESG ratings leading to reduced firm-specific volatility and lower downside tail risk in the first year of trading. In this paper, the authors calculate the idiosyncratic risk in accordance with Ritter (1991), the capital asset pricing model and Fama-French three-factor model is used. Even though this particular thesis studies the relationship in the revelatory stage of initial public offerings, we believe that their arguments and findings can be contributional for our thesis, studying more mature companies.

Continuing, the European Banking Authority (EBA, 2020) points out the importance of ESG as well as the risks it entails, and how it can impact individual institutions or financial systems as a whole. Furthermore, the EBA explains the ESG factors may have an impact on several aspects of both financial- and non-financial risks, such as: operational-, credit-, liquidity-, market- and funding risks. The EBA suggests that the impact of influence on these risks may be depending on business activities, for example, stage in life cycle, geographic location and size. This aspect thus opens up the questions of how different sectors are affected by ESG and if there are any discrepancies depending on what market the companies are traded on. Further discussing the benefits of ESG in a financial setting, Cerqueti, Ciciretti, Dalò & Nicolosi (2021) study ESG investing as a possible measure to reduce risk. In their research, they analyze the liquidation of different ESG rated portfolios in a stress scenario. Their findings resulted in evidence of the relative loss of high ESG rated funds subceeding that experienced by the lower ESG rated counterparts in a time frame of lower volatility. However, during a higher volatility setting, there is no clear evidence of dominance of one over the other.

One thing that can generally be drawn from all of the above previous literature is the heavy focus on analyzing firms in the United States. However, we were not able to find any evidence of these findings being able to be generalized for additional countries across the world. By changing the scope and analyzing Swedish companies, as done in our thesis, we are able to analyze if previous findings persist for different countries, or if ESG have different effects depending on countries.

# 3 Research Framework

This chapter will further delve into the existing literature while analyzing the relevant approaches and methods used to establish a relationship between ESG and idiosyncratic risk. With the information presented and our own intuition, we will construct hypotheses regarding the outcome of our thesis.

## 3.1 ESG

As mentioned in the previous chapter, ESG might be perceived as diffuse and its framework and how it is measured is not always consistent. There are different ways of measuring and quantifying ESG, one way could be measured on a scale from AAA to CCC, where the former is awarded to companies with the greatest ESG work (MSCI, 2022). Another way of measuring ESG is instead made on a numerical scale ranging from 0 to 100, where 100 indicates the best possible rating. In addition to the aggregate ESG score, some ESG rating providers report and award ratings based on the individual pillars. In this thesis, we use monthly ESG-ratings from Sustainalytics, which quantifies a firm's aggregate ESG score as well as its individual pillars, E, S and G separately on a numerical scale from 0 to 100. By including an analysis of the individual pillars, we will be able to establish potential discrepancies between the categories of ESG, and if there is a larger significance of any such pillar. An important note to consider is that ESG scores provided by third parties should be considered an important research tool and not a definitive fact. As mentioned earlier the work that constitutes ESG is not easily quantifiable and the selection process to determine what work constitutes ESG and what doesn't is arbitrary (Schoenmaker & Schramade, 2019; Signore, San-Jose, Retolaza & Rusconi, 2021)

One difficult aspect regarding ESG data concerns its availability, data on e.g. ESG-ratings are usually updated on a yearly basis and is a fairly new topic. In order to effectively perform the methodology a large dataset is required. Sustainalytics, as used in this thesis, do however provide ESG-ratings updated on a monthly basis. An additional characteristic of ESG data is the small changes between periods, if any changes at all. ESG data are characterized as relatively stable over time, but can exhibit larger changes over longer periods of time. We discuss the rating development of our data set further in chapter 4.

## 3.2 Idiosyncratic Risk

Risk is a very wide term and could entail different meanings depending on the context. Mainly within finance, risk could broadly be interpreted as the combination of systemic- and idiosyncratic risk. In this case, the former can be interpreted as the risk of a whole financial market or system collapsing (Kaufman, 2000). The latter on the other hand, idiosyncrasy, instead refers to the risk entailed to a specific entity, in this thesis it entails company specific risk. In order to take a step away from the generally wide definition of risk, we focus on the idiosyncratic risk. By focusing on the idiosyncratic risk, we will only analyze how the companies' ESG rating affects the company specific risk, without the influence of market factors. Since simply computing volatility based on the actual returns exhibited by the firm will capture both the systematic and idiosyncratic risk, we need to extract the latter part. Moreover idiosyncratic risk is not priced in the stock market as it is theoretically diversifiable, which makes it important to consider (Reber, Gold & Gold, 2021). The idiosyncratic volatility of the firms, which captures the market-perceived firm-specific risk, reflects the market perception of the firm's business and financial risk. Hence it is an important measure to capture risk compared to e.g. accounting-based measures, as they can easily be manipulated by managers etc.

There are numerous ways of calculating the idiosyncratic risk, however, an often recurring approach is the use of a Fama and French model, more specifically the three-factor Fama and French model (Fama & French, 1993). The model serves as an expansion of the traditional CAPM due to its limitations. Previous literature has considered the three-factor Fama and French model to model the idiosyncratic risk of firms. See e.g. Ang et. al. (2006), Bali & Cakici (2008) and Reber, Gold & Gold (2021).

## 3.3 Delimitations

As argued in the previous chapter, ESG factors could potentially affect the risk in publicly traded companies. Risk, however, is a wide term and could be measured in numerous different ways. One reoccurring and widely used measure of risk is volatility, which is the risk parameter we analyzed in this thesis. Furthermore, we want to isolate the effect on the firm-specific risk, and thus will only analyze the idiosyncratic volatility, as opposed to total volatility which includes the systematic volatility, i.e. market risk. Moreover, one can consider credit risk by e.g. looking at the spread on Credit Default Swaps (CDS) as a parameter instead of the market risk mentioned

above. Furthermore, idiosyncratic volatility includes both upside and downside risks, i.e. positive or negative returns, but it is more likely that investors are more concerned about downside risks. Hence one could consider e.g. VaR and CVaR, which according to Artzner, Delbaen, Eber & Heath (1999) captures downside idiosyncratic risk.

Furthermore, to bring more depth and insight into our research we will not solely rely on the aggregated ESG rating, instead, we will have the addition of analyzing the individual pillars of ESG. We believe that this will contribute to a greater understanding of how ESG ratings relate to idiosyncratic risk and if there are any potential discrepancies between the individual pillars of ESG. One aspect of using the knowledge of potential discrepancies between the pillars, could lead to beneficial insight into what pillar is most important in order to mitigate risk, and be perceived as less risky by investors.

In addition to this, we will further narrow the scope by analyzing Sweden, which will allow us to contribute to the existing literature by comparing our results and the possibility of generalization across countries.

## 3.4 Hypothesis Formulation

As discussed above, there are various sources analyzing the correlation between ESG and risk and finding negative results, where some are statistically significant, while others are not significant. To this, it is argued that because of the broad definition of ESG it can influence company risk on several different parameters. The reasoning behind this nature of thought mainly has its foundation in the market perception of long-term business and financial risk for a firm, and as previously mentioned could lead to inconsistent business operations in terms of supply chain relationship and financing, etc.. With this in regard, together with our own intuition, we believe that we will find evidence that firms with better ESG work, i.e. higher ESG rating, are perceived as less risky by the market, i.e. have lower idiosyncratic volatility.

While analyzing the drivers behind ESG ratings and idiosyncratic risk, we broadly find two schools of thought regarding their relationship. The first view could stem from the market, where investors perceive companies with higher ESG rating as less risky. The second view is instead interpreted as less risky companies might be more inclined to make larger investments to increase their ESG work which translates to a higher score. In this thesis we will mostly focus on

the former view. The relationship is most likely not a one-way street and the causal relationship is bi-directional. Mature, larger and thus firms deemed less risky are usually the firms that have adequate resources, knowledge and skill to effectively implement ESG policies. However, more effective ESG policies is not only a function of less risky firms, it most certainly reduces risk at a firm-specific level through multiple channels. For example, better ESG implementations reduce exposure to future adverse changes in legislation and it reduces risk of reputational damage that can be devastating. Additionally, firms that invest in long-term sustainable resources, production techniques and supply chains will have an advantage compared to competitors, especially when considering a longer time horizon. Looking at the individual pillars, there are clear risks associated with each one of them that firms need to consider. Corporate governance failures such as managers focusing on short-term profits rather than considering the long-term interests of investors can be detrimental. Environmental risks include increasing direct costs due to e.g. property damage stemming from more intense and frequent hurricanes as oceans get warmer (Bryan, 2020). There are also indirect costs as consumer preferences change and shift towards more environmentally-friendly products, therefore if a firm is lacking in their ESG work the loss of customers may be substantial. Social risks are broad, they can range from security issues, product- and workplace safety to diversity. E.g. failing to adequately take care of employees will hinder firms in retaining and attracting talents (Bryan, 2020). To summarize, a focus on ESG and its pillars should therefore reduce the volatility of cash flows and increase profitability. Since the returns exhibited on the stock market by firms is, at least fundamentally, driven by cash flows and profitability, firms with better ESG policies (and a higher ESG rating) will exhibit more positive returns and lower volatility.

As outlined above, we believe that a greater ESG work will be beneficial to companies, both in their day-to-day work as well as in the eyes of investors. We present these thoughts based on arguments from EBA (2020), Reber, Gold & Gold (2021), Goss & Roberts (2011) as well as our own thoughts and intuition. Because of this, we hypothesize that higher ESG ratings as a whole indicates lower idiosyncratic volatility. When it comes to the effect of the individual pillars our hypothesis is similar, firms with greater ratings will tend to exhibit lower idiosyncratic risk. However, the individual pillars of ESG and which pillar might have the strongest effect, it is difficult to predict since certain pillars may be more important for certain firms, sectors etc.

# 4 Data

As previously discussed, a lot of previous research is mainly focused on the US which might not properly capture cultural and behavioral aspects of other countries. Because of this, we have decided to change the scope and analyze Sweden to see if we can find any continental differences and if our results could be generalized to the Nordic region. In this chapter, we will explore the Swedish data set considered in this thesis, as well as discuss descriptive statistics surrounding it. Furthermore, we also present any potential characteristics that can affect our results.

## 4.1 Description of Data

The data set considered in this thesis consists of historical ESG ratings, as well as ratings for its individual pillars, for 98 different publicly traded companies of varying size and sector within Sweden. Throughout this thesis we gather historical data ranging between the time period of 2009 to 2019, however, because of the lack of the historical data of ESG ratings and the relative youth of some companies, this range is not consistent for all companies considered.

To this, we also include the historical returns of the companies in question which are consistent with the time period corresponding to the ESG rating available for each company. Stock prices are gathered via FactSet. Relating the historical data of returns with ESG ratings, there are no limitations regarding its collection. The only factor hindering its historical length arises if companies were younger than ten years, or not publicly listed within the time frame considered.

In addition to ESG ratings and returns, to extrapolate the idiosyncratic risk we have gathered data on Fama-French equally weighted factors consistent with the geographical location of our data set. More specifically, we use a three-factor Fama-French method, using: market excess returns, size factor, and value factor, in coherence with Fama & French (1993), Ang, Hodrick, Xing & Zhang (2006), and Bali & Cakici (2008). The historical data on the Fama-French factors are gathered from the Swedish House of Finance. Lastly, while conducting the regression of the idiosyncratic volatility on the ESG ratings, we make use of additional control variables accounting for leverage, size, price-to-book (P/B) and return on assets (ROA). The choice of the control variables is motivated by the variables relevance for company risk. If relevant variables, such as leverage, are not controlled for it we can not exclude their influence on our result. Thus,

by capturing the effect of the relevant control variables, it will help us pinpoint the relationship between ESG and idiosyncratic volatility.

## 4.2 Descriptive Statistics

In this subchapter, we analyze and discuss our data sample in order to see if there are any potential characteristics that could influence our result and the ability to generalize the findings.

As previously mentioned, the data considered consists of companies of various sizes and sectors in Sweden. One of the most outstanding characteristics is the division between the sizes, where the data is heavily weighted towards the larger firms. The divisions between large-, mid-, and small cap are 71, 23, and 4 individual companies respectively. Because of this, our findings might suffer inconsistency and inability of generalizing for firms of smaller sizes, and the results may be more robust for large- and mid-sized firms than small firms.

**Table 1**
Average rating divided by market

| **Average rating, market** | Number of firms | ESG | E | S | G |
|---|---|---|---|---|---|
| Full Sample | 98 | 66.0 | 64.2 | 65.4 | 69.5 |
| Large Cap | 71 | 66.7 | 65.4 | 66.3 | 69.3 |
| Mid Cap | 23 | 62.6 | 58.2 | 60.9 | 71.5 |
| Small Cap | 4 | 58.4 | 50.7 | 59.7 | 67.9 |
| Largest value | | 66.7 | 65.4 | 66.3 | 71.5 |
| Lowest value | | 58.4 | 50.7 | 59.7 | 67.9 |

The table shows the average, largest and lowest rating for both the aggregate ESG ratings and the rating of the individual pillars divided by market capitalization. The sample covers monthly ratings in the time frame 2009-2019 provided by Sustainalytics.

Table 1 depicts the average ESG rating, and the average of each individual pillar, grouped by size of the traded firms. What we can deduce from this table is that small cap is characterized by the lowest rating in all individual categories. Large cap on the other hand exhibit the opposite with the highest rating in all categories, except for the governance pillar which is attributed to mid cap. The finding of larger companies exhibiting higher ESG ratings is however not surprising. These are often relatively more mature companies and thus have had both more time and more funds to invest and develop greater ESG work than smaller and less mature companies.

**Table 2**
Average rating divided by sector

| **Average rating, sector** | Number of firms | ESG | E | S | G |
|---|---|---|---|---|---|
| Energy | 2 | 69.1 | 61.6 | 73.3 | 73.9 |
| Materials | 7 | 72.6 | 73.2 | 73.2 | 71.3 |
| Industrials | 24 | 67.9 | 65.5 | 66.6 | 72.9 |
| Consumer Discretionary | 15 | 66.1 | 62.8 | 65.5 | 72.0 |
| Consumer Staples | 7 | 68.4 | 64.8 | 70.9 | 69.2 |
| Health Care | 14 | 57.6 | 64.2 | 52.8 | 59.3 |
| Financials | 11 | 62.2 | 56.4 | 65.0 | 64.9 |
| Information Technology | 4 | 67.0 | 68.6 | 65.7 | 67.5 |
| Communication Services | 4 | 62.6 | 59.4 | 58.4 | 74.4 |
| Utilities | 1 | 58.3 | 51.0 | 59.1 | 69.0 |
| Real Estate | 9 | 66.6 | 68.2 | 64.1 | 67.1 |
| Largest value | | 72.6 | 73.2 | 73.3 | 74.4 |
| Lowest value | | 57.6 | 51.0 | 52.8 | 59.3 |

The table shows the average, largest and lowest rating for both the aggregate ESG ratings and the rating of the individual pillars divided by sector, classified by MSCI (2020). The sample covers monthly ratings in the time frame 2009-2019 provided by Sustainalytics.

Table 2 presents the average ESG rating, and the average of the individual pillars, grouped by sector in coherence with MSCI's global industry classification standard (MSCI, 2020). In this division we can see that the highest and lowest ratings vary slightly more than with the previous division. The highest overall ESG rating is attributed to the materials sector while the lowest rating is exhibited by health care. For both the social and governance pillar, the lowest rating is given to the health care sector while the highest is characterized by the energy sector and communication services sector respectively. The sector with the highest environmental rating is materials, while the sector with the lowest rating is utilities. What additionally can be drawn from the above table is the amount subjected to each sector. As can be seen, the majority of the observations are attributed to four sectors (roughly 66%), namely, industrials, consumer discretionary, health care, and financials. Once again, because of the weight towards these sectors instead of a uniform distribution, the findings within this thesis might be more true for the mentioned sectors in particular.

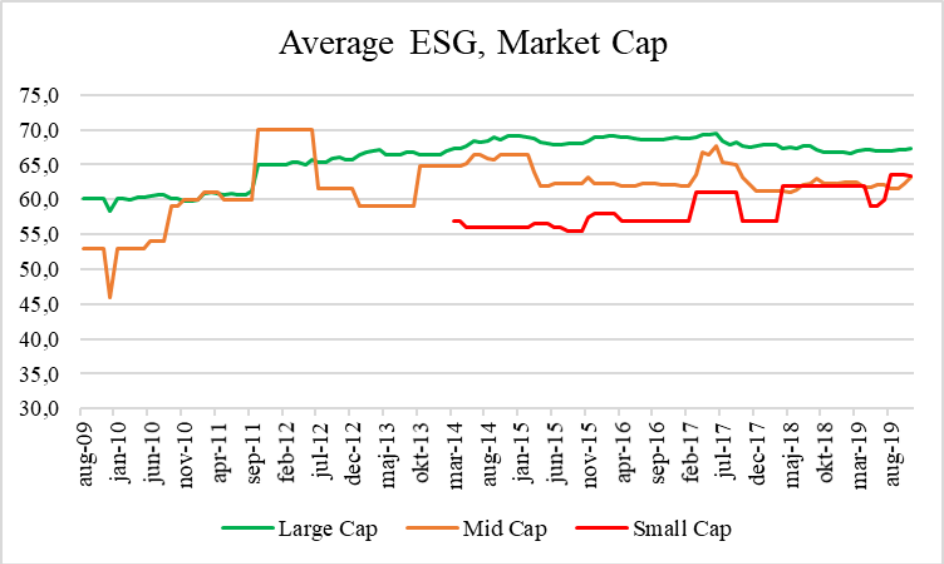


**Figure 1**. Average aggregated ESG rating. The graph plots the average ESG divided by market capitalization, large cap, mid cap, and small cap. The average ESG is for the time period from 2009 to 2019.

Figure 1 depicts the average ESG rating for our data sample over the analyzed time period, grouped by the considered market capitalization. A conclusion that generally can be drawn from our sample is that ESG scores are relatively consistent over time, experiencing a few jumps throughout the years. However, these perceived jumps in average rating could be the aftermath of "new entries" subjected with "outlying rating" in the data sample for a company that has not been previously rated. Because of this, the above development of the average during the time frame should be considered with care. If we disregard this we can see a slight increasing trend in all groups, with large cap experiencing the most stable development and both mid cap and small cap experiencing more volatility in average ESG rating. The individual ESG pillars generally follow the same pattern in relation to each other, developing in the same manner as the aggregate ESG rating presented above. In the small market capitalization group, the environmental pillar does however experience an inverse development in comparison to the other pillars, see appendix figure 1A - figure 3A.

One noteworthy aspect that can be drawn from table 1, 2, figure 1 and 1A-3A is the development of both the aggregate ESG rating and its individual pillars throughout the considered time frame. During this time period, the ESG ratings are relatively constant which could possibly influence our results. The relatively small monthly change, if any, might not be able to confidently capture the effect on idiosyncratic volatility, further discussion on this matter is presented in chapter 6.2.

**Table 3**
Descriptive statistics of the control variables

| **Variable** | Mean | Median | SD | Min. | Max. | Skewness | Kurtosis | N |
|---|---|---|---|---|---|---|---|---|
| ESG | 66,0022 | 67,0000 | 10,1607 | 41,0000 | 88,1300 | -0,1305 | -0,8166 | 6478 |
| E | 64,1453 | 65,0000 | 14,0541 | 33,0000 | 97,0000 | -0,0860 | -0,7549 | 6478 |
| S | 65,4312 | 65,0000 | 10,7780 | 34,0000 | 94,0000 | 0,0169 | -0,4061 | 6478 |
| G | 69,5617 | 70,0000 | 10,7016 | 41,0000 | 98,0000 | -0,1563 | -0,3203 | 6478 |
| Leverage | 0,2619 | 0,2547 | 0,1557 | 0,0000 | 0,9892 | 0,7925 | 1,3064 | 5934 |
| Size | 16256,4021 | 7029,2560 | 19446,6563 | 17,8320 | 99562 | 1,2100 | 0,9332 | 6387 |
| ROA | 0,0649 | 0,0580 | 0,0737 | -0,4544 | 0,6038 | 0,6520 | 6,8269 | 6385 |
| P/B | 4,2715 | 2,2455 | 99,3936 | -1130,4348 | 4414,4144 | 40,1828 | 1818,5257 | 6419 |

The table shows the descriptive statistics of the full undivided data sample for aggregate ESG, its individual pillars, leverage, size, return on asset, and price-to-book. The descriptive statistics considered are the mean, median, standard deviation, minimum value, maximum value, skewness, and excess kurtosis.

Figure 2 shows the descriptive statistics for the aggregated ESG, individual pillars, and the control variables. Leverage is defined as the amount of total debt in relation to total assets, ROA is a profitability ratio measured as the return in relation to each firm's total assets, size is measured as total assets in million SEK, and P/B is the ratio between the market value and book value of equity. Regarding the companies analyzed, both the aggregated ESG and the individual pillars, the mean and median values lie relatively close to each other with governance exhibiting slightly larger values than the others. Considering these four variables, the environmental pillar had the lowest value, 33, while the governance had the largest value of 98.

Furthermore, both the aggregate ESG ratings and its individual pillars exhibit negative excess kurtosis, i.e. platykurtic, meaning that the distribution is characterized by thinner tails and flatter peaks, in comparison to a normal distribution. The skewness on the other hand is also negative, except the social pillar which has a positive skewness of 0.0169. This thus means that all ESG variables generally are skewed to the right, whereas the opposite applies to the social pillar.

Both the median and mean leverage lies between 25% with a standard deviation of 0.1557. The lowest leverage experienced is 0% while the highest leverage is almost 99%. The firms in our dataset are of different sizes with the mean resulting in roughly 16 256 million SEK while the median only amounted to 7029 million SEK, and a standard deviation of 19 446. The smallest and largest size of the companies are roughly 18 and 99 562 respectively. When it comes to the ROA, the mean and median lies relatively close to each other and 6.49% and 5.8% respectively. The minimum and maximum ROA, however, are substantially different with the lowest return being negative of 45% while the largest is positive at 60.38%. For the P/B-ratio comparison, the

average value is four times higher than the book value, and the median is roughly half of the mean at twice the book value. The minimum and maximum P/B-ratio reported for the analyzed firms were extremely different from each other, where the minimum value reported is -11308 times lower than their book value, while on the other hand the largest value is 4414 times higher. These large negative and positive values might come as a surprise, but there is an explanation behind this surprising outcome. The negative minimum value is attributed to Swedish Match and the reasoning behind it being negative has its foundation in that their debt is larger than their assets and thus resulting in negative equity in order to maintain balance in the balance sheet. For the largest value, Lundin Energy experienced a very low book value of equity of around 0.02 during certain years, resulting in the abnormally high P/B ratio. Thus these two outliers skew the descriptive statistics significantly which is an important note to mention.

Lastly, for all control variables, they exhibit both positive skewness and positive excess kurtosis, i.e leptokurtic. Because of this, in comparison to a normal distribution, the control variables are characterized as being skewed to the right, as well as a higher peak and fatter tails.

# 5 Methodology

In this chapter we present our chosen model and a step-by-step guide of its implementation in order to analyze if the idiosyncratic risk is different for higher- and lower ESG ratings.

The methodology and estimation process can be divided into two steps, firstly we quantify the idiosyncratic volatility corresponding to each firm and each month considered in the dataset. Secondly, we estimate panel regressions where we analyze how the level of ESG-rating impacts the idiosyncratic volatility.

The first step, i.e. quantifying the idiosyncratic volatility, is based on a Fama-French three-factor model, hereby denoted as FF3, as outlayed by Eugene Fama and Kenneth French (Fama and French, 1993). This methodology is in line with Ang, Hodrick, Xing & Zhang (2006) and Bali and Cakici (2008). To estimate the idiosyncratic volatility we first need to compute the returns on a daily basis for each firm considered during the time period corresponding to available ESG data.

(1) $$R_{i,\,t} = \frac{P_{i,\,t} - P_{i,\,t-1}}{P_{i,\,t-1}}$$

$P_{t,\,i}$ denotes the share price of firm $i$ at time $t$. To estimate the idiosyncratic volatility, we assume that the return of each firm, $i$, is driven by the three factors laid out in the FF3-model: market excess return, the outperformance of small versus big firms and the outperformance of high book-to-market versus low book-to-market, furthermore that the returns are driven by a firm-specific shock, $\varepsilon_{i,\,t}$. Thus we run the following regression on daily observations separately for each month and firm for which we have data on the firm's ESG-rating.

(2) $$R_{i,t} - r_{f,t} = \beta^{i}_{MKT} Z_{m,t} + \beta^{i}_{SMB} SMB_t + \beta^{i}_{HML} HML_t + \varepsilon_{i,t}$$

Where $r_{f,\,t}$ is the risk-free rate at time $t$, $Z_{m,\,t}$ is the excess return on the market at time $t$, i.e. return on all stocks traded on the Swedish stock market. $SMB_t$ and $HML_t$ is the excess return on a small-minus-big size portfolio and high-minus-low book-to-market portfolio respectively. The

idiosyncratic volatility of firm $i$ is computed by taking the standard deviation of the firm-specific shock $\varepsilon_{i,t}$ as follows:

$$IV(d)_i = \sqrt{var(\varepsilon_{i,t})} \quad (3)$$

Thus we end up with monthly observations of the idiosyncratic volatility for each firm $i$, however since the FF3 regression is made on a daily basis, the volatility estimates are on a daily basis and needs to be scaled up on a monthly basis as follows:

$$IV(m)_{i,T} = IV(d)_i \times \sqrt{s} \quad (4)$$

Where $s$ denotes number of trading days belonging to each month $T$. After calculating the above equations for each company, corresponding to the timeframe of the ESG ratings, we transform our results to a panel data set. The regressions are in coherence with Sassen, Hinze & Hardeck (2016). Firstly, we fit the main two regressions of the thesis based on equation 5 and 6 where the first one uses the aggregated ESG rating and the second one uses the individual pillars in one regression.

$$IV(m)_{i,T} = c + \beta_{ESG} ESG_{i,T} + \beta_{LEV} LEV_{i,T} + \beta_{SIZE} SIZE_{i,T} + \beta_{ROA} ROA_{i,T} + \beta_{P/B} P/B_{i,T} \ldots \quad (5)$$
$$\ldots + \sum_{q=1}^{11} \beta_d YEAR_{q,i} + \epsilon_{i,T}$$

$ESG_{i,T}$ denotes the aggregated ESG score for firm $i$ and time $T$. $LEV$, $SIZE$, $ROA$ and $P/B$ are the control variables leverage, size, return on assets and price-to-book respectively. $c$ is a constant and $\epsilon$ an error term.

$$IV(m)_{i,T} = c + \beta_E E_{i,T} + \beta_S S_{i,T} + \beta_G G_{i,T} + \beta_{LEV} LEV_{i,T} + \beta_{SIZE} SIZE_{i,T} + \beta_{ROA} ROA_{i,T} \ldots \quad (6)$$
$$\ldots + \beta_{P/B} P/B_{i,T} + \sum_{q=1}^{11} \beta_d YEAR_{q,i} + \epsilon_{i,T}$$

Equation 6 is identical to equation 5 except $E$, $S$ and $G$ denotes the individual pillars. Where $E_{i,T}$, $S_{i,T}$ and $G_{i,T}$ denotes firm $i$'s environmental, social and governance score respectively at time $T$.

In addition to this, we include year dummies to capture time-related effects, for example periods of abnormal volatility. Since our dataset ranges from 2009-2019 we use in total 11 dummy variables. When using dummy variables one needs to be considerate of a trap, namely the dummy variable trap. This trap constitutes a scenario where two or more variables are highly correlated, or multicollinear. To avoid falling into the dummy variable trap, one variable should be omitted from the regression (Suits, 1957).

Above equations dictate our starting point. Due to high correlation amongst the three pillars E, S and G, as shown in the next chapter, we fit three more specifications with the pillars on an individual basis as per below:

$$(7)\quad IV(m)_{i,T} = c + \beta_E E_{i,T} + \beta_{LEV} LEV_{i,T} + \beta_{SIZE} SIZE_{i,T} + \beta_{ROA} ROA_{i,T} + \beta_{P/B} P/B_{i,T} \ldots + \ldots + \sum_{q=1}^{11} \beta_d YEAR_{q,i} + \epsilon_{i,T}$$

$$(8)\quad IV(m)_{i,T} = c + \beta_S S_{i,T} + \beta_{LEV} LEV_{i,T} + \beta_{SIZE} SIZE_{i,T} + \beta_{ROA} ROA_{i,T} + \beta_{P/B} P/B_{i,T} \ldots + \ldots + \sum_{q=1}^{11} \beta_d YEAR_{q,i} + \epsilon_{i,T}$$

$$(9)\quad IV(m)_{i,T} = c + \beta_G G_{i,T} + \beta_{LEV} LEV_{i,T} + \beta_{SIZE} SIZE_{i,T} + \beta_{ROA} ROA_{i,T} + \beta_{P/B} P/B_{i,T} \ldots + \ldots + \sum_{q=1}^{11} \beta_d YEAR_{q,i} + \epsilon_{i,T}$$

We perform several tests in order to evaluate our data and methodology. Firstly we perform a Lagrange multiplier test as outlined by Breusch and Pagan (1980) in order to investigate if there exists individual heteroskedasticity. Moreover, this test outlines if pooled ordinary least squares (OLS) is an appropriate model or not. A significant test statistic suggests heteroskedasticity and pooled OLS would therefore lead to biased estimators. Our test result is highly significant when considering equation 5 to equation 8 outlined above, heterogeneity is present and pooled OLS should not be used. See appendix table 1A for the Breusch-Pagan test results for all specifications.

In addition to this, since we are working with panel data, we need to determine whether a model with fixed effects or random effects is most relevant for our data. Hence, we perform a Hausman test (Hausman, 1978). Under the null hypothesis a model with random effects is preferred due to higher efficiency while under the alternative fixed effects is at least as consistent and thus preferred. When performing the test we fail to reject the null hypothesis for the main specifications, i.e. equation 5 and equation 6, thus a model with random effects should be used, see table 2A in the appendix. We also performed the Hausman tests for the three additional specifications. The result from the Hausman tests is reported in table 3A in the appendix. In all three cases, a model with random effects is preferred. Moreover, since the Breusch-Pagan test indicated heteroskedasticity we fit the model using clustered standard errors grouped by firm.

# 6 Results

The following chapter presents the result which is founded in the methodology and data used in the thesis. The first section reports the result of a correlation test and the six specifications, i.e. aggregated ESG score and the individual pillars E, S and G respectively. The second section analyzes and discusses the results as well as relating it to the hypothesis outlined earlier. The final section mentions limitations and improvements for future research.

## 6.1 Regression Results

Before performing the regression analysis we estimate the correlation between the idiosyncratic volatility, aggregate ESG, its individual pillars, and all control variables. Table 4 illustrates the correlation between the different variables considered in the dataset. The most notable result is found in the first column. As can be seen, the aggregated ESG-score and the social pillar are negatively correlated with idiosyncratic volatility while the environmental and governance pillars are positively correlated. The positive correlation is somewhat confusing, however none of the correlations are statistically significant. The only significant correlation exhibited between idiosyncratic volatility and variables included in the regression is with ROA.

**Table 4**
Pairwise correlation, idiosyncratic volatility, ESG and control variables

| **Variable** | Idiosyncratic Vol. | ESG | E | S | G | Leverage | Size | ROA | P/B |
|---|---|---|---|---|---|---|---|---|---|
| Idiosyncratic Vol. | 1.0000 | | | | | | | | |
| ESG | -0.0002 | 1.0000 | | | | | | | |
| E | 0.0135 | 0.8803*** | 1.0000 | | | | | | |
| S | -0.0171 | 0.8641*** | 0.6292*** | 1.0000 | | | | | |
| G | 0.0163 | 0.7461*** | 0.5014*** | 0.5104*** | 1.0000 | | | | |
| Leverage | -0.0102 | -0.0636*** | -0.0141 | -0.1064*** | -0.0352 | 1.0000 | | | |
| Size | 0.0117 | 0.0315** | 0.0409*** | 0.0011 | 0.0462*** | 0.0961*** | 1.0000 | | |
| ROA | -0.0561*** | -0.0982*** | -0.0921*** | -0.0458*** | -0.1312*** | -0.1649*** | -0.0195 | 1.0000 | |
| P/B | -0.0015 | 0.0160 | -0.0023 | 0.0299** | 0.0177 | 0.0318** | 0.0269 ** | -0.0592*** | 1.0000 |

The table shows the pairwise correlation between the aggregate ESG, the individual pillars and all control variables considered, against each other. Standard errors are reported in parenthesis. *, ** and *** indicate significance at the 10%-, 5%- and 1% level respectively

The results of each company specific idiosyncratic volatility from our first step, the Fama-French three-factor model, is presented in the appendix figure 4A. As can be seen in the figures, the companies experience varying time span and volatility throughout the considered time frame.

During the time frame of the sample, the idiosyncratic volatility for each company is relatively stable. However, one aspect occurring repeatedly for many of the observed companies is the abnormal increase in idiosyncratic volatility during the period of 2017-2018. This increase in IV does not overlap perfectly with each other, but the "spike-like" behavior does however lie close to one another. Furthermore by visual inspection there's clear evidence of heteroskedasticity, which our Breusch-Pagan test previously confirmed.

Table 5 presents the results from the two specifications based on equation 5 and 6 outlined in chapter 4. Specification 1 is equation 5, i.e. relating the idiosyncratic volatility (IV) as a function of aggregated ESG score and specification 2, equation 6, relates IV to the individual pillars of ESG separately. Specification 2 is included in order to understand what factors of ESG are the most important for the risk of firms. An important note to add is that the number of observations dropped to 5824. The reason for this stems from multiple issues. Firstly, firm's such as banks and other financial institutions have been removed since it is difficult to measure leverage as the capital requirements are heavily regulated and abnormal (Sassen, Hinze & Hardeck, 2016). Moreover, due to issues surrounding the availability of control variables for certain firms during specific time periods, a number of observations had to be dropped. Initially we can clearly see a consistent negative relationship between IV and ESG, the control variables and the year dummies. When considering specification 1, the relationship between the IV and ESG is significantly negative, albeit at the lowest level 10%. The coefficient is -0.0007 which means that if, at any given time period, the firm's ESG score is 1 unit higher the idiosyncratic volatility is on average 0.07 percentage points lower. We discuss the relationship more thoroughly and relate it to our hypothesis in the following subchapter. Turning our eyes towards the control variables we can clearly see that the relationship between them and the idiosyncratic risk is negative. Return on assets (ROA) is significant at the 5% level, price-to-book is significant at the 10% level while size and leverage are both insignificant for both specifications. ROA is a profitability measure since it captures the firm's capabilities to generate profits in relation to its assets. Moreover, the negative relationship indicated by the model is both economically and intuitively reasonable. Firms that are more effective in generating profits present stable and/or growing cash flows, thus their risk, as deemed by the market, is lower.

**Table 5**
Aggregated and disaggregated ESG regressions.

| Variables | Specification 1 | Specification 2 |
|---|---|---|
| ESG | -0.0007* | |
| | (0.0004) | |
| E | | -0.0003 |
| | | (0.0005) |
| S | | -0.0002 |
| | | (0.0006) |
| G | | -0.0001 |
| | | (0.0005) |
| LEV | -0.0551 | -0.0540 |
| | (0.0399) | (0.0393) |
| Size | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) |
| ROA | -0.1651** | -0.1636** |
| | (0.0749) | (0.0744) |
| P/B | -0.0000* | -0.0000* |
| | (0.0000) | (0.0000) |
| Constant | 0.2180* | 0.2074*** |
| | (0.0404) | (0.0388) |
| R-Squared | 0.0296 | 0.0293 |

Specification 1 is based on equation 5 and specification 2 is based on equation 6. Both specifications are panel data regressions fitted with random effects and clustered standard errors by firm. Clustered standard errors are reported in parenthesis. *, ** and *** indicate significance at the 10%-, 5%- and 1% level respectively.

A high price-to-book ratio is generally attributed to growth stocks, conversely value stocks usually have a lower P/B. Hence, the negative relationship shown by Table 5 is somewhat confusing. The source of value for growth stocks, at least fundamentally, lies in future earnings and earnings growth. The fundamental value of value stocks on the other hand lies closer to today and value stocks are usually mature and well established companies. Hence, theoretically, value stocks should be less risky. Thus, the negative relationship between P/B and IV is somewhat confusing. However the coefficient is sufficiently small so the effect is negligible in both cases. As mentioned, the coefficients for leverage and size are negative and insignificant in both specifications. Larger firms tend to be less volatile so the negative coefficient exhibited by size is not surprising. The result surrounding leverage is somewhat confusing. Highly levered firms are, at least intuitively, more risky. It may be the case that the stocks in sectors

characterized as highly levered, e.g. real estate, have been relatively stable across our considered timeframe. However, the purpose of this thesis is not to delve deeper into the relationship between leverage and risk, because of this we leave the interpretation at that. As can be seen by Table 5A in the appendix, the year dummies for specification 1 and 2 are all negative, except 2018, and highly significant in both specifications. The year 2017 is left out in order to avoid the dummy variable trap.

As can be seen by the pairwise correlation table the individual pillars E, S and G are highly correlated with each other. Hence, the results obtained from specification 2 might be misleading and the statistical insignificance may occur due to the variables being highly correlated with each other. With this in mind we fit three more regressions, specification 3, 4 and 5.

**Table 6**
Regressions on E, S and G individually. Specification 3, 4 and 5 is with E, S and G respectively.

| Variables | Specification 3 | Specification 4 | Specification 5 |
|---|---|---|---|
| E | -0.0004 | | |
| | (0.0003) | | |
| S | | -0.0004 | |
| | | (0.0004) | |
| G | | | -0.0003 |
| | | | (0.0004) |
| LEV | -0.0530 | -0.0553 | -0.0540 |
| | (0.0395) | (0.0391) | (0.0401) |
| Size | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| ROA | -0.1640** | -0.1637** | -0.1612** |
| | (0.0756) | (0.0741) | (0.0753) |
| P/B | -0.0000* | -0.0000* | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| Constant | 0.1946*** | 0.1961*** | 0.1898*** |
| | (0.0382) | (0.0368) | (0.037) |
| R-Squared | 0.0289 | 0.0302 | 0.0292 |

Specification 3, 4 and 5 are regressions on E, S and G individually based on equation 7, 8 and 9.. All specifications are panel data regressions fitted with random effects and clustered standard errors by firm. The year dummies are reported in the Appendix. Clustered standard errors are reported in parenthesis. *, ** and *** indicate significance at the 10%-, 5%- and 1% level respectively.

The regression result is presented in table 6. As can be seen, even when running the regressions on an individual basis neither E, S or G is significant at any level. However, the negative relationship is still consistent amongst the three pillars. Moreover, the size of the coefficients for the E- and S pillars are similar to each other, while G has the smallest coefficient amongst the three. Once again, the year dummies can be found in the appendix, table 6A for specification 3 to specification 5.

To further investigate the relationship between idiosyncratic volatility and ESG we fit a univariate model in order to see how the result changes when control variables are left out. Once more, we perform a Hausman test in order to evaluate the appropriate model, the result is found in appendix table 4A. Table 7 presents the result from the univariate regression. As can be seen the result changes dramatically. The coefficient for ESG switches to positive and is highly insignificant. Moreover the R-squared is extremely low. This points to the necessity of the control variables. A regression without them leads to inconclusive and insignificant results. Hence the results presented below should be interpreted with caution.

**Table 7**
Univariate panel regression on idiosyncratic volatility using random effects and clustered standard errors.

| Univariate Panel Regression | |
|---|---|
| ESG | 0.0003 |
| | (0.0003) |
| Constant | 0.0974*** |
| | (0.0238) |
| R-Squared | 0.0000 |

This table shows the results from the univariate panel regression with random effects and clustered standard errors. Clustered standard errors are reported in parenthesis. *, ** and *** indicate significance at the 10%-, 5%- and 1% level respectively.

## 6.2 Discussion

The purpose of this thesis is to analyze how ESG relates to the firm-specific risk of firms in Sweden. Specifically, we examine both the aggregated ESG, its individual pillars and the relationship to idiosyncratic risk, and if there are any discrepancies between the pillars.

The results achieved from our regressions are coherent with our hypothesized outcome, that higher ESG rating indicates lower idiosyncratic volatility. Moreover it is in line with previous research, e.g. Friede, Busch & Bassen (2015), in the sense that ESG is a significant factor in relation to the stock market. Furthermore, our results on the ESG-risk relationship are in coherence with Sassen, Hinze & Hardeck (2016) in which they used a similar methodology on a European dataset. Even though our result gives an indication of a consistent negative relationship between ESG-ratings and idiosyncratic risk, all outcomes are not statistically significant. The aggregated ESG is statistically significant on a 10% confidence level, but none of the individual pillars resulted in statistical significance, but indicate a negative relationship. Additionally, what can be deduced from table 5 and table 6 is the negative coefficient of ESG in all specifications with control variables. This clearly points to our hypothesis and framework established earlier. Firms with high ESG-scores tend to exhibit lower idiosyncratic volatility, i.e. firm-specific risk. There are multiple channels through which ESG policies reduce risk. As mentioned earlier, a disregard of ESG-policies in the full value-chain of a firm may increase the firm's exposure to future changes in regulation that can have detrimental effects on production capabilities and the supply chain. Moreover, there may be substantial fines associated with e.g. environmentally damaging production techniques and firm’s that do not adhere to consumer- and societal preferences may suffer massive reputational damage. In summary, firm’s that implement good ESG-policies and have received a high rating have less business risk and are perceived as less risky by the market.

Additionally, even though the results are insignificant, the individual pillars indicate an influence of varying degree, thus giving rise to different magnitudes on idiosyncratic volatility following a change in rating. The regressions from table 5 points to the environmental pillar having the largest effect on idiosyncratic volatility, where one higher unit in rating relates to 0.03 percentage points lower idiosyncratic volatility. The second most influential ESG pillar is the social pillar, which gives rise to a lower idiosyncratic volatility of 0.02 percentage points. Lastly, the

governance pillar is the least influential of the three pillars resulting in 0.01 percentage points lower idiosyncratic volatility relating to one higher unit in rating. By analyzing from a market perspective, these results can thus be interpreted as to reflect the importance of each pillar of ESG, where environmental is the most important one, followed by social with governance being the least important. However when performing the regressions on an individual basis the size of the coefficients are similar for the E- and S pillar while being smaller for G. Thus it is difficult to pinpoint which pillar is the most important one as the result differs between the specifications. An important note to stress is that none of the above results is significant at any level and should thus be interpreted cautiously.

It is difficult to generalize the above result to other countries. There are a lot of country-specific reasons that influence the ESG-risk relationship such as market perception of the importance of ESG, legal frameworks and regulations as well as firms' own preferences. However, one might hypothesize about similar results for similar countries. For example, all the Scandinavian countries are somewhat homogenous in regards to culture and regulations and thus might experience similar results, but drawing these conclusions should be made with caution. The conclusions can not reasonably be drawn for significantly different countries such as emerging markets as the differences are too large.

Conducting research surrounding the ESG-risk relationship might cause some difficulties when it comes to statistical significance. Even though idiosyncratic volatility can be computed at, basically, any frequency, ESG ratings are the opposite. ESG is often discussed in a long-term spectrum, and thus is not updated as often. Most commonly, ESG rating providers update their ratings annually, however, some give updates on a monthly basis. In addition to this, the change in ratings are often very small, and only result in an increase/decrease of a few (often single) points on a 0 to 100 scale, see figure 1 in chapter 4.2 or figure 1A - 3A in the appendix. Because of this and the large time span in relation to risk measures, to capture its relation to risk could lead to results where the statistical significance is low.

The results presented in this thesis could serve beneficial to many entities, such as analysts, investors, policymakers and more. To exemplify this, regarding the perspective of investors, our results indicate that an integration of ESG factors in an investment strategy could lead to a mitigation of firm-specific risk. In relation to this, it puts further emphasis on the case of

corporate actions to be made with ESG improvements activities, which in turn could potentially increase shareholder value in terms of decreased firm-specific risk which is followed by a lower cost of capital (Plumlee, Brown, Hayes & Marshall, 2015).

## 6.3 Limitations and Suggestions for Future Research

One of the greatest limitations that occurred while conducting this thesis is related to the data availability of ESG ratings for firms listed in Sweden. This limitation has somewhat hindered us on a few parameters. Firstly, ESG scores are relatively new and thus the historical data is limited, leading to our data set being of different time frames depending on the specific firm. Even though we strive to achieve greater historical depth, this was not possible in each case. Secondly, in our data set, there is an overrepresentation of large cap firms compared to both mid- and small cap. Making our result more skewed towards larger firms. Moreover, an interesting extension is to investigate how the relationship changes over time by dividing the sample into two parts. However, due to the lack of ESG-data, few data points for firms exist in the beginning of our sample making a split of the dataset difficult in our case.

All of the above mentioned limitations might cause some difficulties in generalizing our results across different parameters. Moreover, as previously mentioned the lack of historical data could further have influenced the statistical significance of our results.

In this thesis we made the decision to solely use Swedish data. Because of this, the results provided can not be generalized to other countries or continents, since country specific effects and behavior might have a different impact in comparison to Sweden. However, the countries within the Nordic region are relatively similar to each other to some extent, thus, our findings might give an indication of what the effects could be in these countries, this generalization should however be made with caution. This country-to-country comparison is one aspect we believe is missing with our thesis, and we believe that this insight would be a great addition to bring further insight into the subject.

To further improve on our research, and the ESG topic in general, an additional analysis of how ESG influences risk between sectors could be expanded on. Many sectors differentiate greatly from each other, and the market perception of the importance of ESG could potentially differ as well. We believe that delving deeper into this thought would be both interesting and beneficial to

gain a deeper understanding of the sectoral differences with regards to the ESG-risk relationship. In addition to this, to bring further depth into this topic of research ESG on risk, further research should consider analyzing additional risk measures. In this thesis we have solely focused on the idiosyncratic volatility, while we got results indicating a negative relationship, this is only one risk measure of many. For example, further research could analyze VaR, Expected Shortfall or systemic risk instead of firm-specific risk. Additionally it is interesting to extend the dataset and consider ratings compiled by different institutions. In this thesis we solely have ratings from Sustainalytics and as previously mentioned the definition of ESG is not universally agreed upon, hence the ratings provided by the different institutions are distinct. Thus by including ratings from different institutions the results are more robust and on top of that, one can see the discrepancies between the different rating-institutions

Lastly, one important factor within the research area of ESG is time. As of today, ESG is still a relatively new aspect within the world of finance, and as discussed in the beginning of this thesis, there is no universally agreed upon framework and to quantify ESG is still somewhat diffuse. However, ESG is gaining more traction and attention in many areas as time passes by, and we believe that more insightful research is able to be made in the future as ESG-ratings become more frequent and robust.

# 7 Conclusions

The purpose of this thesis is to analyze the relationship between ESG and firm-specific risk. In order to estimate this relationship a two-step approach is used. Firstly we estimate idiosyncratic volatility on a monthly- and firm basis by using a Fama-French three-factor model on daily observations. Following this we estimate several panel data regression models with random effects and clustered standard errors grouped by firm.

There are several different specifications considered, one with the three pillars of ESG aggregated into one score, one regression with the three pillars E, S and G separated and three specifications on the pillars individually. Moreover, we employ several different control variables accounting for leverage, size, return on assets and price-to-book. The results differ, in terms of statistical significance, between the two main specifications. However, we can consistently see a negative relationship between ESG and idiosyncratic risk, i.e. firms that have been rated highly exhibit lower idiosyncratic risk compared to firms with lower ratings. The results for the first specification are significant at a 10% confidence level while for the individual pillars the result is insignificant in all specifications. Furthermore, our results point to the environmental pillar being the most important, followed by social and lastly governance.

Previous research has concluded that there is a link between ESG performance and performance on the stock market, see e.g. Friede, Busch & Bassen (2015). The link between market risk and ESG is not as conclusive, however our results point to a consistent negative relationship. The market perceives firms with high ESG ratings as less risky, thus the idiosyncratic volatility exhibited by highly rated ESG firms tend to be lower. Besides the market perception there are other clear advantages, from a risk management perspective, of focusing on effective ESG policies. For example the exposure to future changes in legislation are reduced as well as the risk of severe reputational damage.

There are many different and interesting extensions for future research to consider. Comparing different rating agencies and different risk measures such as VaR, Expected Shortfall and Systemic risk etc. Moreover, one can compare the risk of ESG and non-ESG portfolios. Lastly, as ESG data becomes more vast and readily available the robustness of the results will improve greatly.

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# Appendix

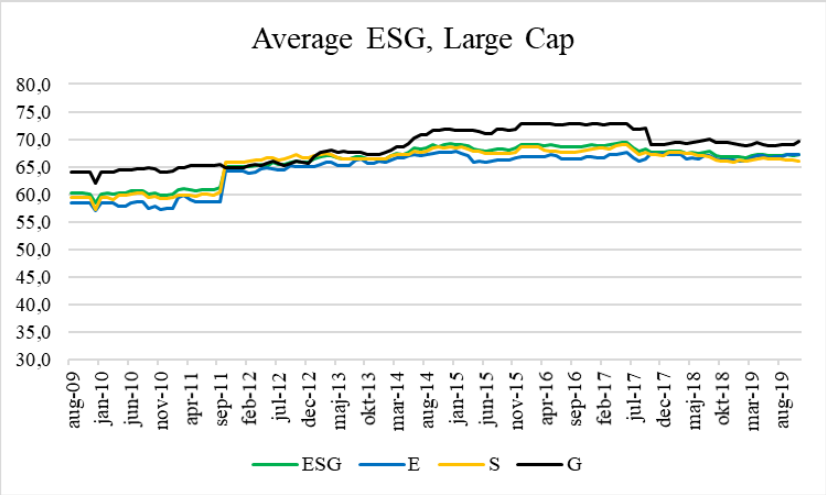



**Figure 1A**. Average aggregate ESG and individual ESG rating of large cap, over the considered time period ranging from 2009-2019.

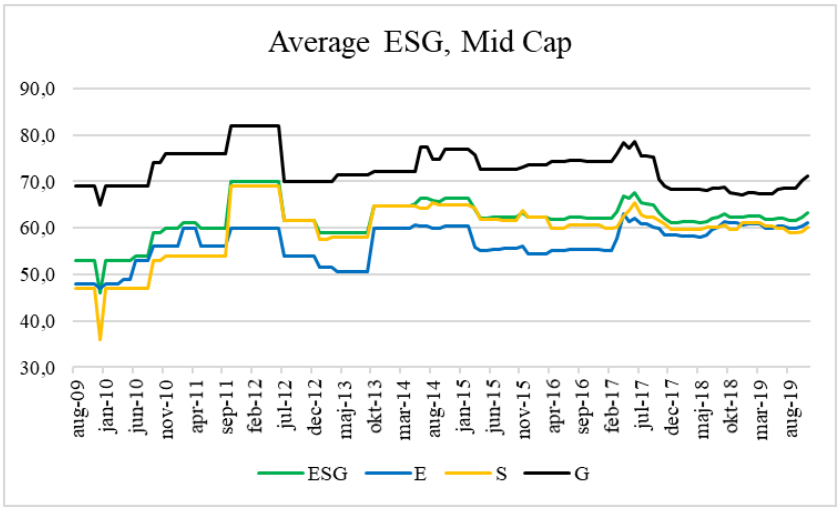



**Figure 2A**. Average aggregate ESG and individual ESG rating of mid cap, over the considered time period ranging from 2009-2019.

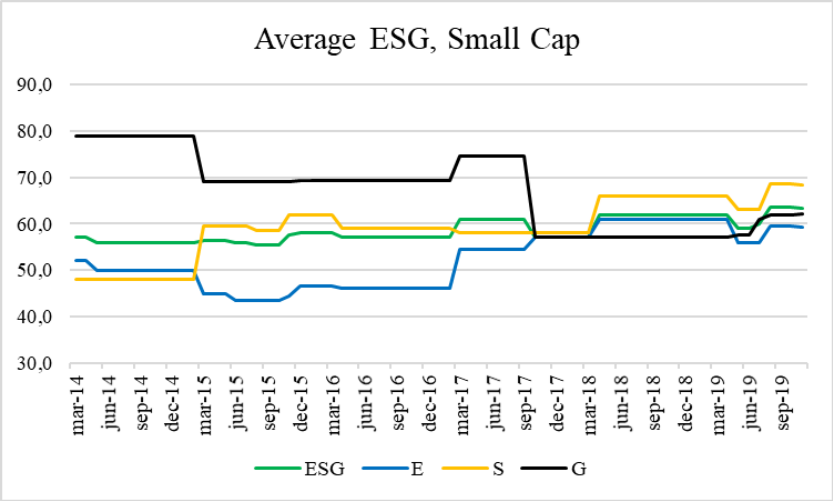



**Figure 3A**. Average aggregate ESG and individual ESG rating of small cap, over the considered time period ranging from 2009-2019.

**Table 1A**
Breusch-Pagan test results for specification 1 and 2

| Breusch-Pagan test for heteroskedasticity | |
|---|---|
| Specification 1 (ESG) | |
| chi2(1) | 11336,29 |
| **p-value** | **0,0000** |
| Specification 2 (E, S & G) | |
| chi2(1) | 10959,32 |
| **p-value** | **0,0000** |
| Specification 3 (E) | |
| chi2(1) | 11181,72 |
| **p-value** | **0,0000** |
| Specification 4 (S) | |
| chi2(1) | 11260,37 |
| **p-value** | **0,0000** |
| Specification 5 (G) | |
| chi2(1) | 11200,30 |
| **p-value** | **0,0000** |

**Table 2A**

Hausman test results for specification 1 and 2

| | Fixed Effects | Random Effects | Difference | Std. Error | Fixed Effects | Random Effects | Difference | Std. error |
|---|---|---|---|---|---|---|---|---|
| ESG | -0,0010 | -0,0007 | -0,0003 | 0,0007 | | | | |
| E | | | | | -0,0005 | -0,0003 | -0,0002 | 0,0004 |
| S | | | | | 0,0002 | -0,0002 | 0,0004 | 0,0004 |
| G | | | | | -0,0008 | -0,0001 | -0,0007 | 0,0005 |
| Leverage | -0,0243 | -0,0551 | 0,0309 | 0,0331 | -0,0230 | -0,0540 | 0,0310 | 0,0330 |
| Size | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| ROA | -0,0881 | -0,1651 | 0,0770 | 0,0329 | -0,0823 | -0,1636 | 0,0813 | 0,0333 |
| P/B | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| y_2009 | -0,0602 | -0,0619 | 0,0017 | 0,0093 | -0,0589 | -0,0605 | 0,0016 | 0,0094 |
| y_2010 | -0,0564 | -0,0596 | 0,0032 | 0,0085 | -0,0552 | -0,0584 | 0,0032 | 0,0086 |
| y_2011 | -0,0468 | -0,0482 | 0,0014 | 0,0068 | -0,0460 | -0,0473 | 0,0014 | 0,0068 |
| y_2012 | -0,0395 | -0,0431 | 0,0036 | 0,0044 | -0,0412 | -0,0425 | 0,0012 | 0,0046 |
| y_2013 | -0,0556 | -0,0590 | 0,0034 | 0,0042 | -0,0569 | -0,0586 | 0,0017 | 0,0043 |
| y_2014 | -0,0585 | -0,0616 | 0,0031 | 0,0029 | -0,0594 | -0,0614 | 0,0019 | 0,0030 |
| y_2015 | -0,0506 | -0,0537 | 0,0031 | 0,0018 | -0,0513 | -0,0537 | 0,0024 | 0,0019 |
| y_2016 | -0,0577 | -0,0615 | 0,0038 | 0,0016 | -0,0576 | -0,0615 | 0,0039 | 0,0016 |
| y_2018 | 0,0545 | 0,0533 | 0,0012 | 0,0019 | 0,0542 | 0,0536 | 0,0005 | 0,0020 |
| y_2019 | -0,0600 | -0,0597 | -0,0003 | 0,0036 | -0,0600 | -0,0593 | -0,0006 | 0,0036 |
| chi2 | 17,78 | | | | | 18,89 | | |
| **p-value** | **0,1660** | | | | | **0,2188** | | |

**Table 3A**

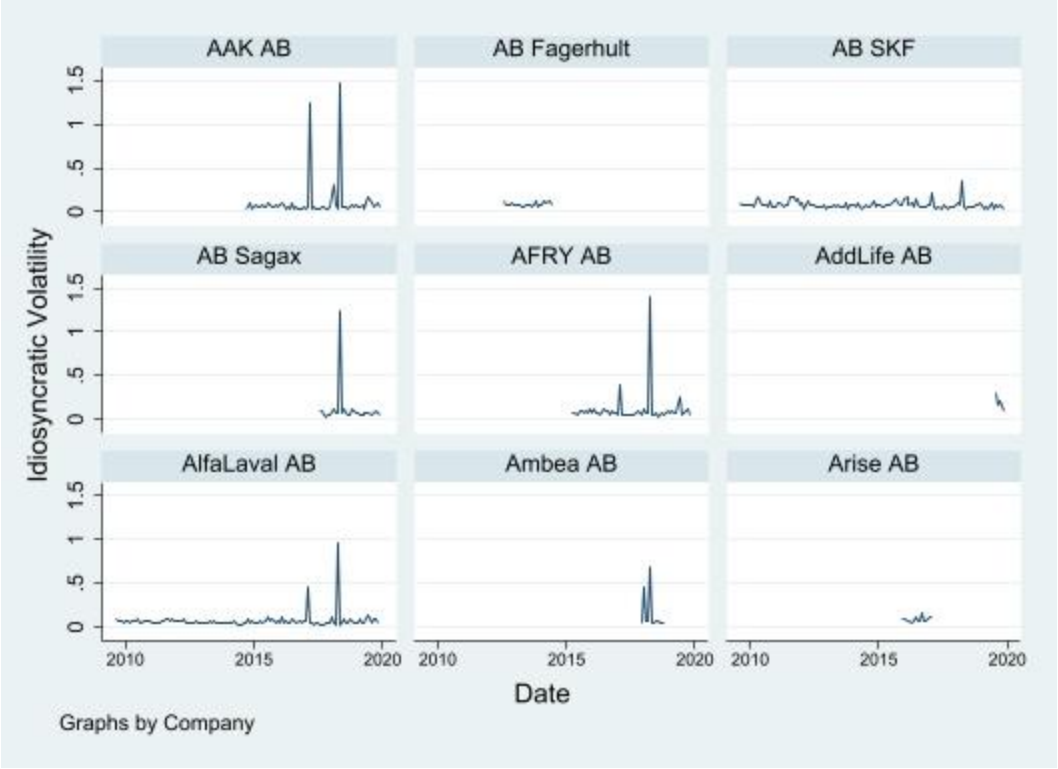
Hausman test results for specification 3, 4 and 5

| | Fixed | Random | Difference | Std. Error | Fixed | Random | Difference | Std. Error | Fixed | Random | Difference | Std. Error |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | -0,0005 | -0,0004 | -0,0001 | 0,0004 | | | | | | | | |
| S | | | | | -0,0001 | -0,0004 | 0,0003 | 0,0005 | | | | |
| G | | | | | | | | | -0,0009 | -0,0003 | -0,0006 | 0,0005 |
| Leverage | -0,0231 | -0,0530 | 0,0299 | 0,0333 | -0,0268 | -0,0553 | 0,0285 | 0,0330 | -0,0266 | -0,0540 | 0,0274 | 0,0329 |
| Size | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| ROA | -0,0897 | -0,1640 | 0,0743 | 0,0328 | -0,0900 | -0,1637 | 0,0737 | 0,0330 | -0,0828 | -0,1613 | 0,0784 | 0,0335 |
| BtM | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| y_2009 | -0,0551 | -0,0587 | 0,0036 | 0,0069 | -0,0492 | -0,0584 | 0,0092 | 0,0069 | -0,0556 | -0,0562 | 0,0006 | 0,0056 |
| y_2010 | -0,0523 | -0,0570 | 0,0047 | 0,0066 | -0,0465 | -0,0564 | 0,0099 | 0,0063 | -0,0519 | -0,0543 | 0,0025 | 0,0051 |
| y_2011 | -0,0437 | -0,0462 | 0,0026 | 0,0055 | -0,0397 | -0,0461 | 0,0064 | 0,0053 | -0,0437 | -0,0446 | 0,0009 | 0,0046 |
| y_2012 | -0,0378 | -0,0420 | 0,0043 | 0,0038 | -0,0355 | -0,0414 | 0,0060 | 0,0033 | -0,0397 | -0,0419 | 0,0022 | 0,0040 |
| y_2013 | -0,0545 | -0,0583 | 0,0039 | 0,0039 | -0,0526 | -0,0578 | 0,0052 | 0,0035 | -0,0557 | -0,0582 | 0,0025 | 0,0039 |
| y_2014 | -0,0579 | -0,0613 | 0,0034 | 0,0028 | -0,0570 | -0,0610 | 0,0041 | 0,0027 | -0,0588 | -0,0614 | 0,0026 | 0,0029 |
| y_2015 | -0,0506 | -0,0538 | 0,0032 | 0,0018 | -0,0498 | -0,0533 | 0,0035 | 0,0017 | -0,0506 | -0,0535 | 0,0029 | 0,0018 |
| y_2016 | -0,0581 | -0,0618 | 0,0037 | 0,0016 | -0,0577 | -0,0614 | 0,0037 | 0,0016 | -0,0572 | -0,0612 | 0,0041 | 0,0017 |
| y_2018 | 0,0554 | 0,0541 | 0,0014 | 0,0020 | 0,0551 | 0,0536 | 0,0015 | 0,0020 | 0,0536 | 0,0534 | 0,0001 | 0,0019 |
| y_2019 | -0,0592 | -0,0589 | -0,0003 | 0,0037 | -0,0600 | -0,0595 | -0,0004 | 0,0037 | -0,0608 | -0,0596 | -0,0012 | 0,0035 |
| chi2 | 17,45 | | | | 17,6 | | | | 18,13 | | | |
| **p-value** | **0,1794** | | | | **0,1732** | | | | **0,1525** | | | |

**Table 4A**

Hausman test results for univariate specification

| | Fixed | Random | Difference | Std. Error |
|---|---|---|---|---|
| ESG | 0,0005 | 0,0003 | 0,0002 | 0,0003 |
| chi2 | 0,47 | | | |
| **p-value** | **0,4927** | | | |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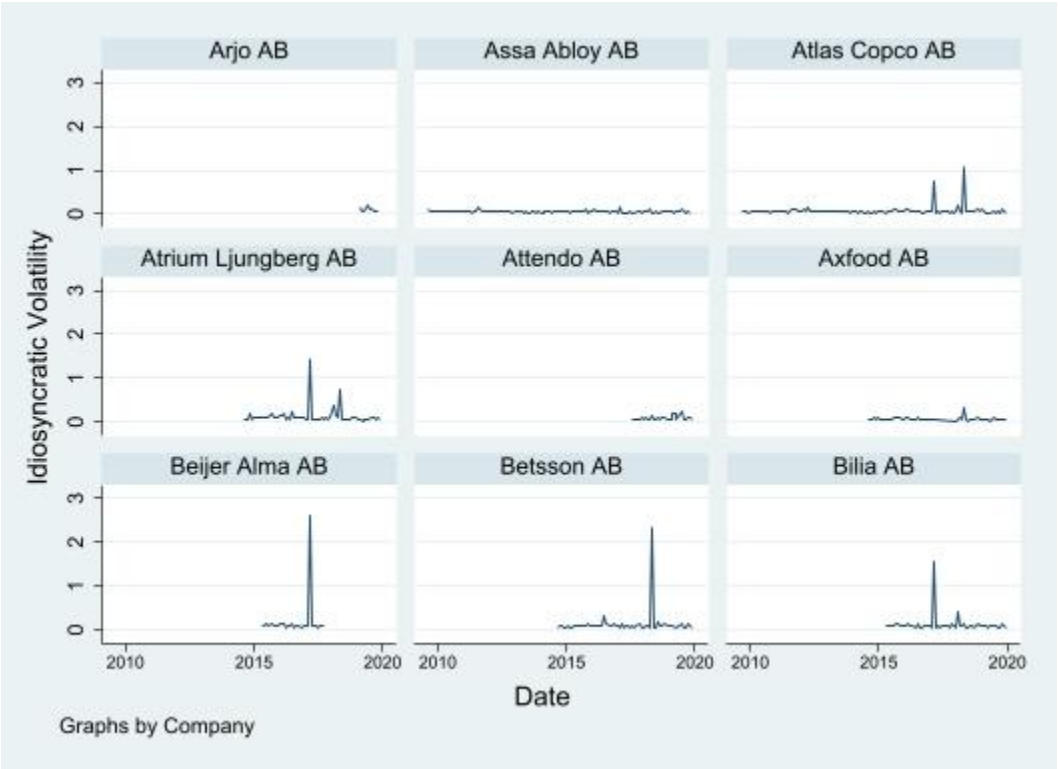
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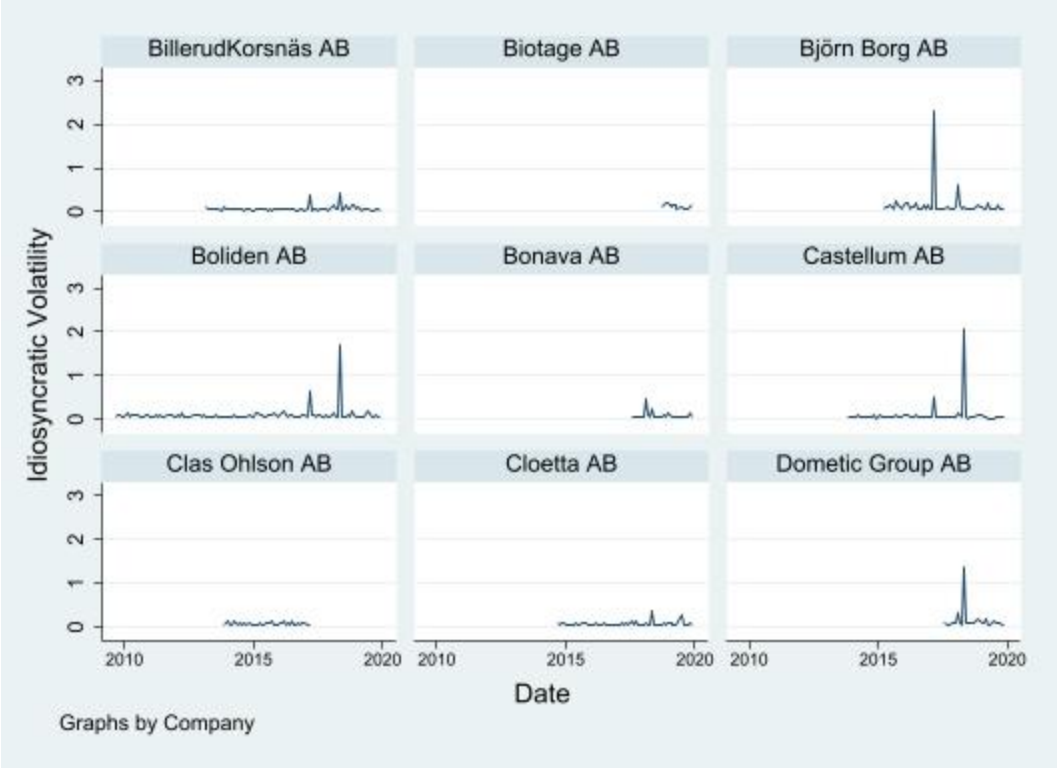
Graphs by Company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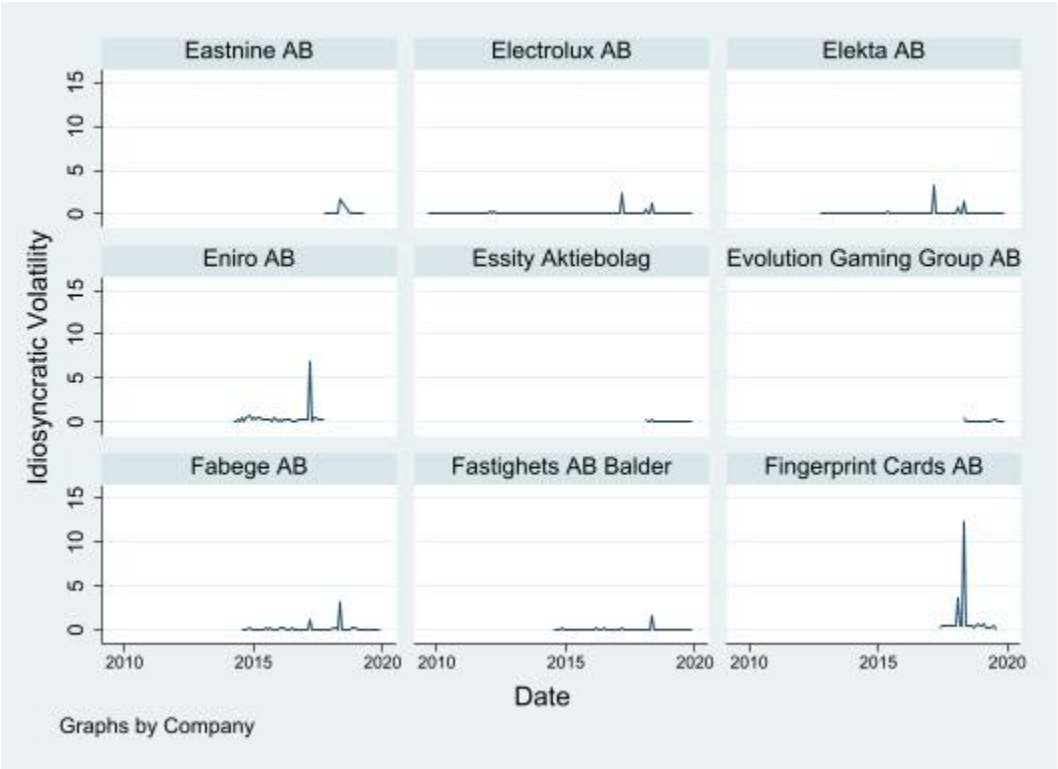
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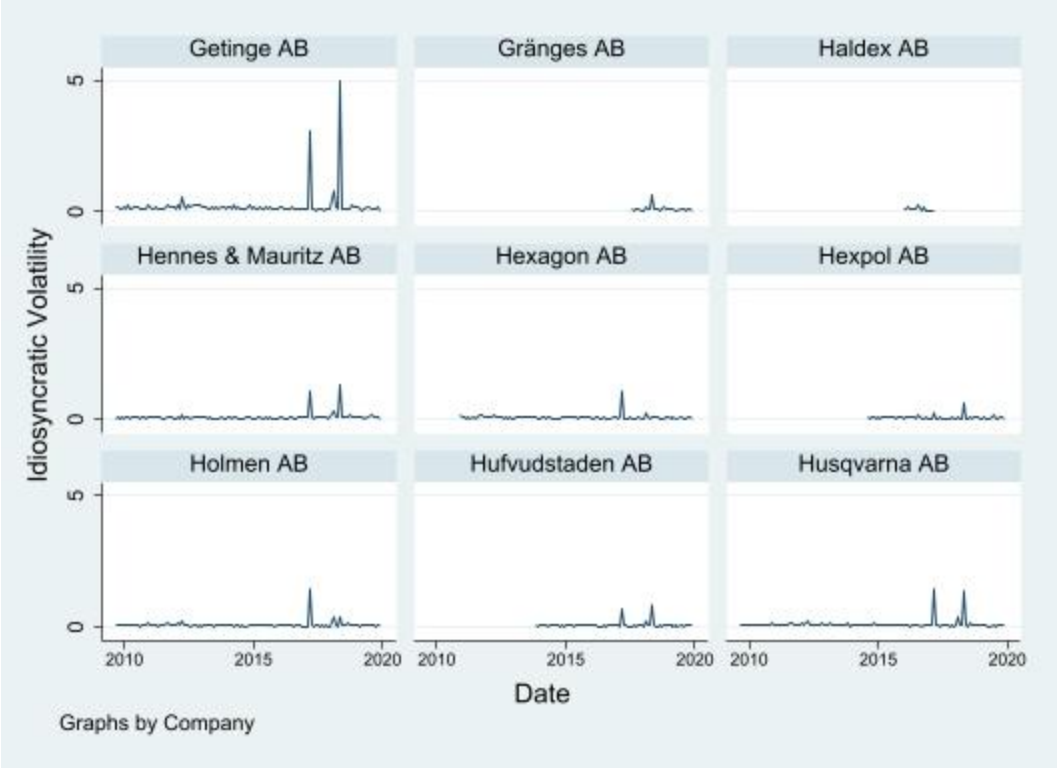
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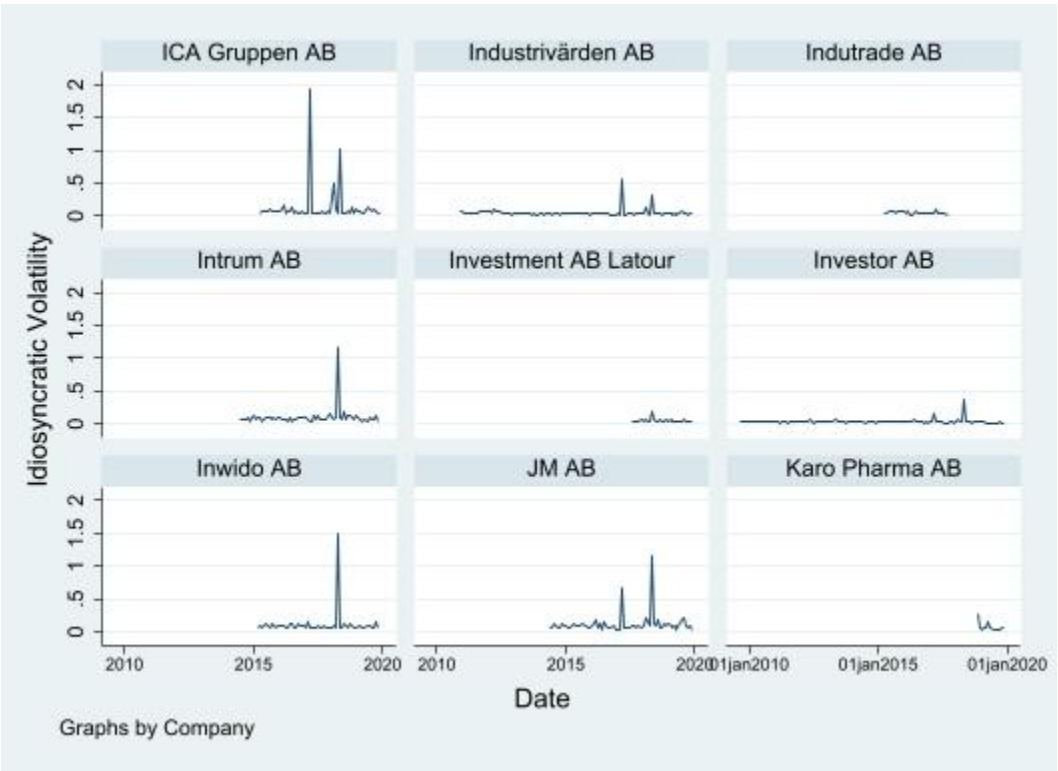
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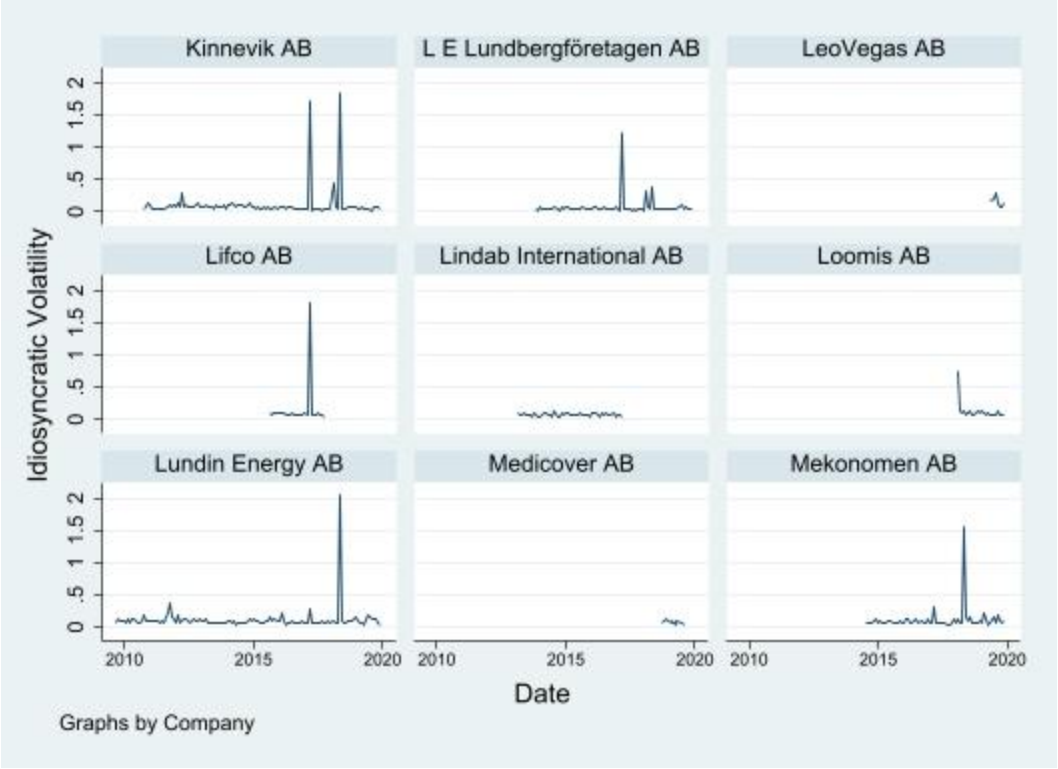
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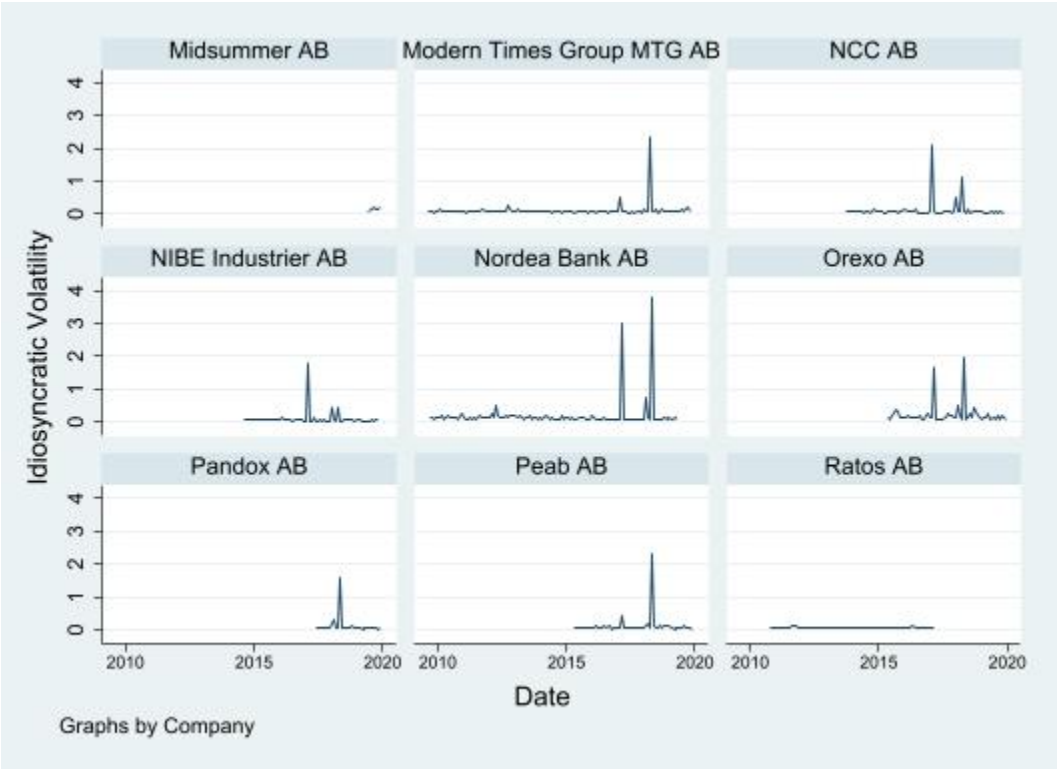
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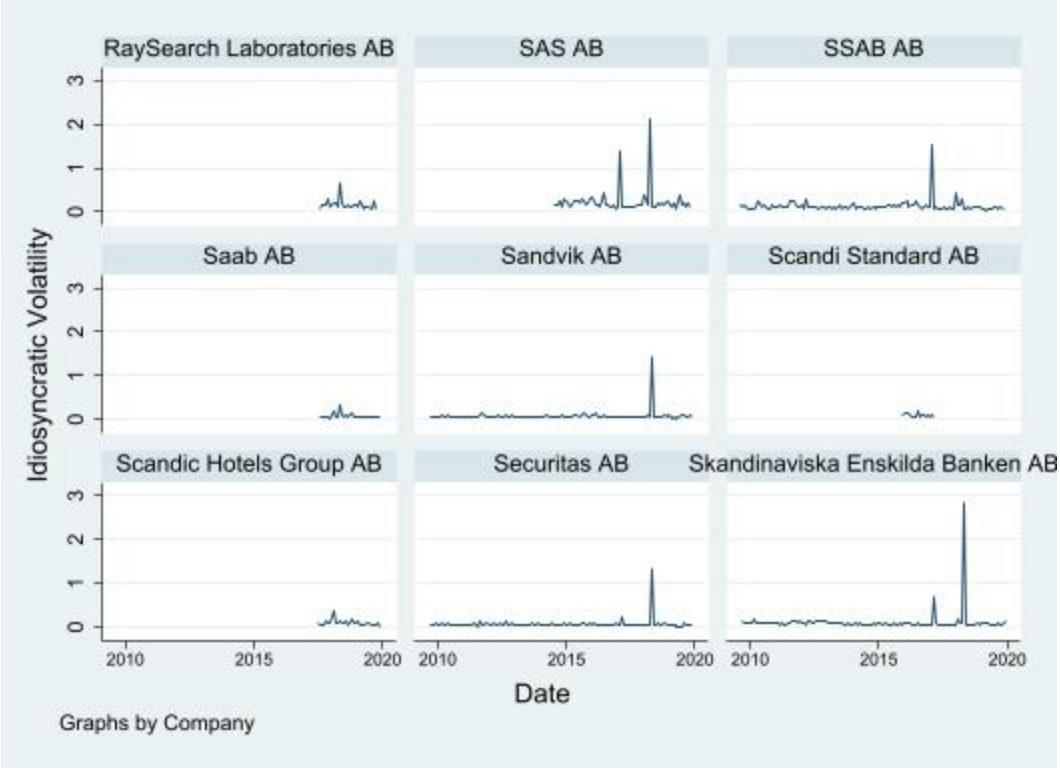
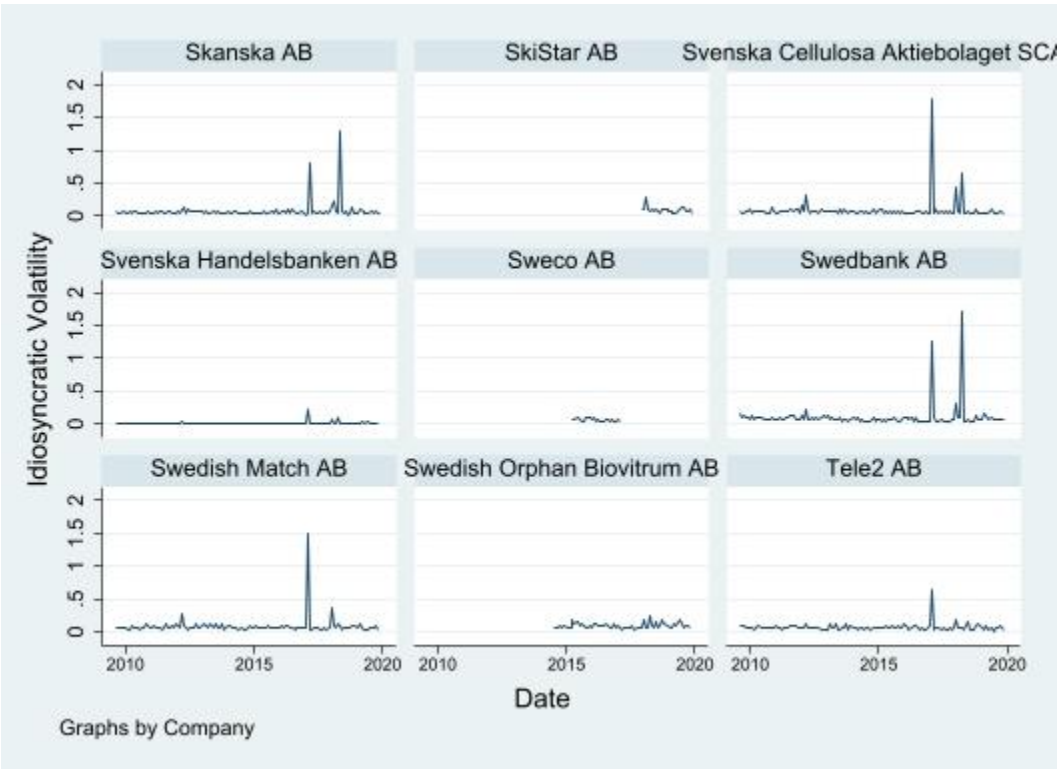
Modern Times Group MTG AB
NCC AB
NIBE Industrier AB
Nordea Bank AB
Orexo AB
Pandox AB
Peab AB
Ratos AB
Idiosyncratic Volatility
0 1 2 3 4
2010 2015 2020
Date
Graphs by Company


RaySearch Laboratories AB
SAS AB
SSAB AB
Saab AB
Sandvik AB
Scandi Standard AB
Scandic Hotels Group AB
Securitas AB
Skandinaviska Enskilda Banken AB
Idiosyncratic Volatility
0
1
2
3
2010
2015
2020
Date
Graphs by Company


Skanska AB
SkiStar AB
Svenska Cellulosa Aktiebolaget SCA
Svenska Handelsbanken AB
Sweco AB
Swedbank AB
Swedish Match AB
Swedish Orphan Biovitrum AB
Tele2 AB
Idiosyncratic Volatility
0
.5
1
1.5
2
2010
2015
2020
Date
Graphs by Company

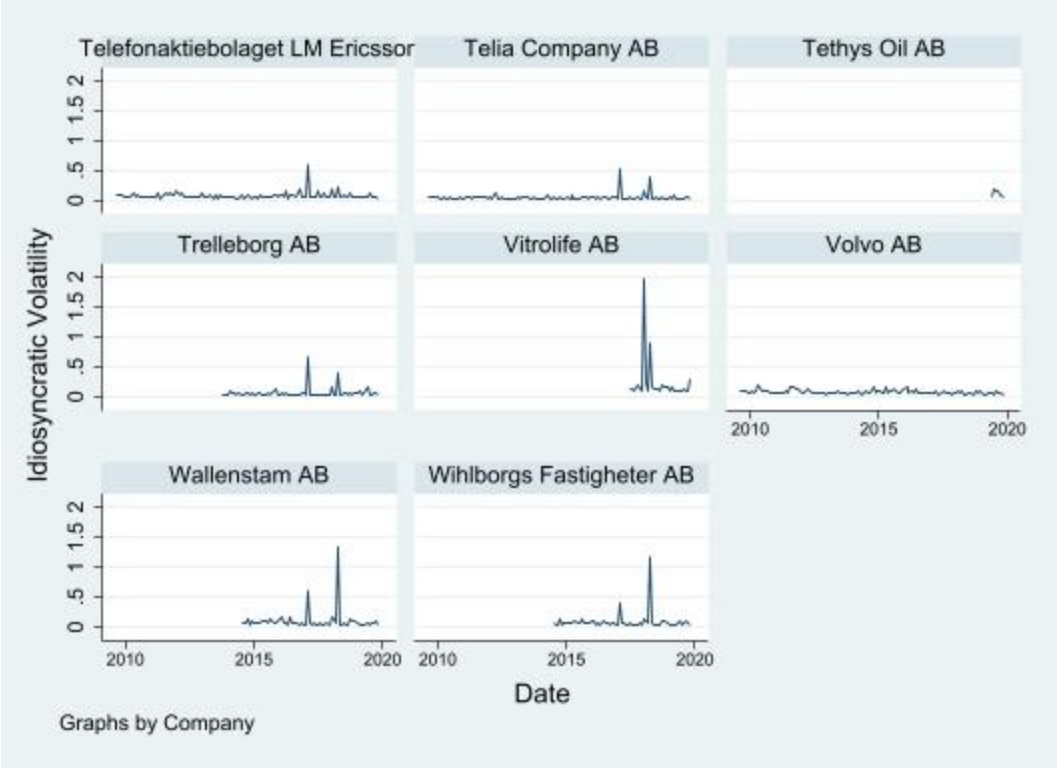



**Figure 4A**. Results from the Fama-French three-factor model displaying the idiosyncratic volatility over the considered time period 2009-2019.

**Table 5A**
Year dummies from specification 1 and specification 2.

| Variables | Specification 1 | Specification 2 |
|---|---|---|
| y_2009 | -0.0619*** | -0.0605*** |
| | (0.0139) | (0.0141) |
| y_2010 | -0.0596*** | -0.0584*** |
| | (0.0134) | (0.0135) |
| y_2011 | -0.0482*** | -0.0473*** |
| | (0.0125) | (0.0127) |
| y_2012 | -0.0431*** | -0.0425*** |
| | (0.0112) | (0.0108) |
| y_2013 | -0.059*** | -0.0586*** |
| | (0.012) | (0.0117) |
| y_2014 | -0.0616*** | -0.0614*** |
| | (0.0124) | (0.0122) |
| y_2015 | -0.0537*** | -0.0537*** |
| | (0.0128) | (0.0127) |
| y_2016 | -0.0615*** | -0.0615*** |
| | (0.0143) | (0.0144) |
| y_2017 | (omitted) | (omitted) |
| y_2018 | 0.0533*** | 0.0536*** |
| | (0.0203) | (0.0201) |
| y_2019 | -0.0597*** | -0.0593*** |
| | (0.0115) | (0.0114) |
| R-Squared | 0.0296 | 0.0293 |

Clustered standard errors are reported in parenthesis. *, ** and *** indicate significance at the 10%-, 5%- and 1% level respectively.

**Table 6A**
Year dummies from specification 3, 4 and 5.

| Variables | Specification 3 | Specification 4 | Specification 5 |
|---|---|---|---|
| y_2009 | -0.0587*** | -0.0584*** | -0.0562*** |
| | (0.0136) | (0.0148) | (0.0124) |
| y_2010 | -0.057*** | -0.0564*** | -0.0543*** |
| | (0.0132) | (0.0139) | (0.0119) |
| y_2011 | -0.0462*** | -0.0461*** | -0.0446*** |
| | (0.0121) | (0.0131) | (0.0116) |
| y_2012 | -0.042*** | -0.0414*** | -0.0419*** |
| | (0.0113) | (0.0112) | (0.0107) |
| y_2013 | -0.0583*** | -0.0578*** | -0.0582*** |
| | (0.012) | (0.0121) | (0.0117) |
| y_2014 | -0.0613*** | -0.061*** | -0.0614*** |
| | (0.0124) | (0.0124) | (0.0123) |
| y_2015 | -0.0538*** | -0.0533*** | -0.0535*** |
| | (0.0128) | (0.0127) | (0.0128) |
| y_2016 | -0.0618*** | -0.0614*** | -0.0612*** |
| | (0.0143) | (0.0142) | (0.0144) |
| y_2017 | (omitted) | (omitted) | (omitted) |
| y_2018 | 0.0541*** | 0.0536*** | 0.0534*** |
| | (0.0202) | (0.0204) | (0.02) |
| y_2019 | -0.0589*** | -0.0595*** | -0.0596*** |
| | (0.0114) | (0.0115) | (0.0113) |
| R-Squared | 0.0289 | 0.0302 | 0.0292 |

Clustered standard errors are reported in parenthesis. *, ** and *** indicate significance at the 10%-, 5%- and 1% level respectively.