UNIVERSITY OF GOTHENBURG

SCHOOL OF BUSINESS, ECONOMICS AND LAW

How does ESG ratings impact information asymmetry in European stock markets?

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Master's thesis in Finance

Spring 2025

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Abstract

This study investigates the relationship between environmental, social and governance (ESG) performance and information asymmetry in European financial markets. Using a panel dataset of large-cap European firms between 2020-2024, the analysis employs three proxies for information asymmetry: bid-ask spread, trading volume, and return volatility. A firm-level fixed effect regression model is used to control for time-invariant characteristics. The results indicate a negative association between ESG performance and all three proxies, suggesting that higher ESG scores may be linked to lower levels of information asymmetry. However, the relationship is not uniformly significant and further research is needed. The connection between information asymmetry and ESG is to our knowledge underexplored within the broader European context and therefore this study aims to fill that gap. As the link between ESG and information asymmetry remains underexplored in the European context, this study contributes with new empirical evidence to an emerging area of academic interest.

Keywords: ESG, ESG-ratings, ESG disclosure, Non-financial disclosure, Information asymmetry

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1 Introduction

1.1 Background

In recent years, environmental, social, and governance (ESG) have become more central to corporate reporting and investment decision making. The European Union's heightened emphasis on sustainability reporting, as evidenced by directives such as the Corporate Sustainability Reporting Directive (CSRD) and the Sustainable Finance Disclosure Regulation (SFDR), has rendered ESG ratings a integral component of investors' decision-making strategies (Hummel and Jobst, 2024). De Klerk et al. (2015) and Qureshi et al. (2020), demonstrate how the integration of ESG factors can enhance financial performance. Furthermore, Van Duuren et al. (2016) demonstrate how ESG can provide valuable insights into a company's risk profile. Dhaliwal et al. (2012) demonstrate how including ESG disclosure results in more accurate analyst forecasts and Cahan et al. (2015) findings demonstrate how CSR (Corporate Social Responsibility) activities enhance firm transparency. ESG disclosures have come to be regarded as a tool for enhancing transparency and thus enabling stakeholders to gain insights into firms' non-financial performance.

A body of previous research has indicated that ESG performance has the capacity to reduce information asymmetry by increasing transparency (Kim and Park, 2023; Dhaliwal et al., 2011; Van Duuren et al., 2016; Serafeim and Yoon, 2021). However, it should be noted that results have been found to vary across different markets and methodological choices. Information asymmetry is a concept that has been the subject of extensive research in a variety of disciplines. In this field of study, researchers have used different combinations of proxies for measuring information asymmetry, offering a comprehensive perspective on the subject. Leuz and Verrecchia (2000), Christensen et al. (2013), Krueger et al. (2024) and Cho et al. (2013) all use bid-ask spread as a proxy, Landsman et al. (2012), Khan et al. (2015) and Chae (2005), trading volume and Elbadry et al. (2015), Kim and Park (2023) and Van Ness et al. (2001), volatility. This thesis uses all three measures concurrently, thus constituting a significant addition to extant research. Kim and Park (2023) describe the relationships between information asymmetry and the respective proxies for measurement. They explain that a wider bid-ask spread and a higher degree of volatility are indicative of higher information asymmetry, and that a higher trading volume may be indicative of lower

information asymmetry. The three proxies for measuring information asymmetry were expected to be influenced by ESG performance differently since ESG was hypothesised to demonstrate a negative relationship with bid-ask spread and volatility, and controversy, was predicted to demonstrate a positive relationship with trading volume, as evidenced by Elbary et al. (2015).

In Europe, where regulatory stipulations have undergone substantial refinement since 2020 (Hummel and Jobst, 2024), research examining this relationship in the context of a comprehensive stock index remains scarce. A number of studies have previously been conducted; however, the majority of these have focused on single countries or on specific sectors. Moreover, there is a limit of studies that have examined the European market in its entirety during the latest regulatory development phase (2020–2024). Consequently, this thesis will contribute to filling that research gap.

1.2 Purpose

This thesis aims to investigate and answer the research question on how ESG ratings impact the information asymmetry within the European stock market. In addition, this thesis centres on the information environment of companies reporting ESG disclosure and are consequently therefore being rated based upon their ESG performance. Previous research on the relationship between ESG and information asymmetry has primarily been conducted in the context of the American stock market. A limited number of smaller studies have been conducted on the Nordic or Swedish market, but very few have focused on the broader European stock market, as this thesis aims to address.

1.3 Contribution

This paper contributes to the growing body of research regarding the relationship between ESG performance and market efficiency by examining how ESG rating impacts information asymmetry. This paper takes a market microstructured approach, analyzing trading volume, volatility and bid-ask spreads as proxies for information asymmetry. Using a panel data regression model, this study provides empirical evidence on how financial markets incorporate ESG-related information. The findings offer practical insights for investors,

corporations and regulators regarding the role of ESG transparency in improving market efficiency.

1.4 Structure

The disposition of this study is presented as follows. Following the introduction, a literary review is presented, including the theoretical framework. This section provides a comprehensive overview of the proxies used in measuring information asymmetry, along with the dynamics between ESG and information asymmetry, drawing upon the findings of preceding research. The subsequent section provides a comprehensive explanation of the data, encompassing both the dataset itself and the complete array of variables used in the analysis. The fourth section is devoted to the exposition of the methodological framework that has been applied, incorporating the model specification, estimation method, and supplementary tests and diagnostics. The fifth section, the results, is where the findings of the analysis are presented, including both regression results and descriptive statistics as well as the correlation matrix. The sixth section presents the discussion, which comprises an analysis connected to both the theoretical framework and previous research. The final section of the thesis offers a conclusion, which includes ideas for future research.

2 Literature Review

2.1 Market efficiency

The relationship between ESG disclosure and market efficiency can be examined through the lens of the Efficient Market Hypothesis (EMH), Stakeholder Theory, Agency Theory, and Signaling Theory. The EMH, introduced by Fama (1970), suggests that financial markets efficiently incorporate all available information into stock prices. In a semi-strong efficient market, ESG disclosure should immediately reduce information asymmetry as investors adjust their valuations based on newly available sustainability-related information. However, according to Berg et al. (2022) ESG data is often complex and inconsistently measured.

In contrast, Stakeholder Theory by Freeman et al.(2010) says companies are accountable to more than just shareholders. From this point of view, ESG disclosure can enhance transparency, legitimacy and investor confidence by reducing uncertainty. Research from Dhaliwal et al. (2011) find that firms with higher ESG disclosure scores experience less information asymmetry and lower financing costs, supporting the notion that ESG transparency benefits financial markets.

Agency Theory (Jenson and Meckling, 1976) provides a framework for understanding the relationship between principals (e.g., shareholders) and agents (e.g., managers). Jenson and Meckling (1976) explains that in the context of corporations, the separation of ownership and control can result in agents acting in their own interests rather than in the best interests of the principal. This misalignment in interest can lead to agency problems, including information asymmetry, whereby agents possess information that is not readily available to the market. This point is illustrated by Ebadry et al. (2015), who found that governance, one of the main pillars within ESG, has a negative relationship with information asymmetry. The findings of Elbadry et al. (2015) and Dhaliwal et al. (2011) lend support to the notion that enhanced ESG disclosures can mitigate agency problems by increasing corporate transparency.

Signalling theory provides a valuable lens through which the impact of ESG practices on the information environment can be viewed. According to Connelly et al. (2011) firms often possess important qualities that are not observable to market practitioners. In order to bridge this gap, firms can send signals, visible actions or disclosures to hint at these hidden traits.

ESG disclosures and overall ESG scores may act as a signal to market participants, conveying information about firm traits not typically observable through regular financial reporting.

2.2 The effects of ESG

As Van Duuren et al. (2016) explains, ESG integration is becoming increasingly common among fundamental equity investors, with the majority of respondents considering ESG factors in their investment process. The research shows that the primary motivation for ESG integration is to enhance financial performance rather than ethical considerations as investors believe that ESG factors can provide valuable insights into a company's risk profile and potential returns. Additional studies from De Klerk et al. (2015) and Qureshi et al. (2020) have shown a positive relationship between ESG disclosure and market performance. Cahan et al. (2015) findings suggest that CSR (corporate social responsibility) activities enhance corporate transparency, leading to a more informed trading activity potentially improving market efficiency. The results of the Dhaliwal et al. (2012) study show that the accuracy of analysts' forecasts is higher for companies that have a stand-alone CSR report. In countries where regulatory policy is more stakeholder-oriented, this positive relationship is more pronounced. Michael and Grüning (2017) found, in their study of German companies, a negative correlation between CSR disclosures and information asymmetry, as well as cost of capital.

Although some research suggests that higher ESG increases transparency there is also research that suggests that this relationship might be less pronounced. Research by Berg et al. (2022) show the divergence in ESG ratings across rating providers which therefore undermines comparability. Christensen et al. (2022) argue that divergence reflects varying interpretations of ESG performance as opposed to measurement error, and that ESG disclosures may be strategically crafted to portray a firm in a favourable light. Kim and Lyon (2015) show that firms often selectively disclose positive ESG activities while omitting negative to signal responsible business practices.

2.3 The relationship between ESG and information asymmetry

Information asymmetry in financial markets can lead to inefficiencies, higher costs of capital, and lower market participation. ESG disclosures have emerged as a channel for increasing

transparency and providing stakeholders with insights into firms' non-financial performance. Existing studies, such as Kim and Park (2023) and Dhaliwal et al. (2011), suggest that enhanced disclosure reduces information asymmetry. Dhaliwal et al. (2011) find that voluntary CSR disclosures reduce the cost of equity by decreasing information asymmetry. Kim and Park (2023) findings indicate a correlation between higher ESG performance and reduced information asymmetry, suggesting that firms with strong ESG performance tend to have more comprehensive information environments, thereby decreasing the information gap between insiders and outsiders. Christensen et al. (2022) examines the effect of mandatory ESG disclosures on capital markets. They find that while these mandates increase the quantity of ESG disclosures they do not necessarily enhance the quality of the disclosures and the information they provide. The authors conclude that mandatory ESG disclosures have limited impact on improving the information environments in capital markets, particularly when the disclosures lack standardization and material relevance. Muslo et al. (2019) find that CSR reporting quality has a positive relationship with analyst forecast accuracy, suggesting that CSR reporting enhances the information environment. The authors also found that this relationship was more pronounced for firms with a history of CSR reporting.

The bid-ask spread is widely recognized as a direct measure of information asymmetry. Studies like Glosten and Milgrom (1985) established a theoretical link between information asymmetry and bid-ask spreads, showing that spreads widen in the presence of informed traders. More recent studies, such as Leuz and Verrecchia (2000), provide evidence that improved transparency reduces bid-ask spreads in international markets. Christensen et al. (2013) use the bid-ask spread as a measure of market liquidity to examine the effects of mandatory IFRS reporting and changes in enforcement on financial markets while Krueger et al. (2024) shows that the introduction of ESG disclosure mandates leads to a substantial decrease in bid-ask spreads. Cho et al. (2013) uses metrics of CSR performance and proxies for information asymmetry, such as bid-ask spreads and analyst forecast dispersion. The findings indicate a robust negative correlation between CSR performance and information asymmetry. This suggests that organisations engaged in CSR initiatives tend to offer more transparent and credible information to the market, thereby narrowing the gap between insiders and external stakeholders.

Trading volume has also been used as a proxy for information asymmetry. Studies by Landsman et al. (2012) and Khan et al. (2015) use abnormal trading volume (AVOL) to investigate the information content of financial reports. Chae (2005) explored the effect corporate announcement has on trading volume around the announcement date, showing that trading volume decreases as information asymmetry increases. Nimalendran (1994) challenged existing models that predicted a positive relationship between trading volume and information among traders. Their findings demonstrated that, when transaction costs were taken into account, trading volume could be negatively associated with the degree of informational asymmetry in the market.

A third commonly used proxy for information asymmetry is stock return volatility. Volatility is commonly used as it reflects investor uncertainty and differing interpretation of information. Elbadry et al. (2015) and Kim and Park (2023) explicitly include stock price volatility as a measure of information asymmetry alongside bid-ask spread and trading volume. Elbadry et al. (2015) hypothesised that there is a direct correlation between the average volatility of stock returns and the degree of asymmetric information. In the study by Van Ness et al. (2001), volatility emerged as the predominant factor, amongst all the proxies employed for quantifying information asymmetries. In addition, Elbadry et al. (2015) also finds that firms with higher governance quality exhibit lower volatility due to a more transparent and consistent information environment.

In accordance with the work of Elbadry et al. (2015), the use of multiple proxies for measuring information asymmetry, bid-ask spread, trading volume and volatility, can provide a robust understanding of the influence of ESG disclosures. Healy and Palepu (2001), in their seminal work, emphasize the importance of using multiple proxies to capture the complex relationship between disclosures and market efficiency. Additionally, Kanagaretnam et al. (2007) highlight the value of integrating complementary measures (e.g., bid-ask spreads, trading volume and volatility) to robustly assess the impacts of information quality on market dynamics

2.4 The impact of ESG disclosure

The paper by Hübel and Scholz (2020) demonstrates the viability and advantages of integrating ESG ratings into asset management. This integration enhances risk assessment and

enables investors to manage sustainability risks while maintaining favourable financial performance. Serafeim and Yoon (2021) investigates the response of stock prices to news pertaining to ESG issues, with a particular emphasis on the impact of ESG ratings and the divergent opinions among rating agencies. The conclusion is that the presence of favourable ESG news results in a positive market reaction, whilst unfavourable news elicits a negative reaction. The magnitude of these reactions is contingent on a firm's ESG rating and the study demonstrated that firms with low ESG ratings experience heightened stock price reactions to positive news. Conversely, for firms with high ESG ratings, the reaction to positive news is less pronounced, as the market may already anticipate favourable performance.

Research by Flammer (2013), Krüger (2015), Capelle-Blancard and Petit (2019), Cui and Docherty (2020) and Dorfleitner and Zhang (2024) also show that negative news stories pertaining to ESG have a more significant impact. The key insights are that negative events have been found to exert a more substantial influence on investor behaviour than positive ones. Cui and Docherty (2020) further demonstrates that unfavourable ESG related information results in substantial overreactions in stock prices, with declines that are frequently disproportionate to the actual impact on firm fundamentals. Investors have been observed to place disproportionate emphasis on ESG characteristics, potentially to the exclusion of other critical firm fundamentals. Dorfleitner and Zhang (2024) also found that the reaction to ESG news differed depending on the company's historical ESG record. Companies with stronger historical ESG records saw a less severe impact of negative ESG news while the positive ESG news had a more pronounced effect on companies with worse ESG records.

2.5 Hypothesis development

It has been demonstrated that companies with strong ESG performance tend to provide more comprehensive and transparent disclosures. This increased transparency has been shown by Kim and Park (2023) to reduce the information gap between insiders and external stakeholders, thereby decreasing information asymmetry. Van Duuren et al. (2016) show that higher ESG performance has the potential to enhance investor confidence by signalling superior risk management and long-term value creation. This increased trust can result in more stable trading patterns. Studies from Leuz and Verrecchia (2000), George and

Nimalendran (1994), Kim and Park (2023) and Krueger et al. (2024) have demonstrated that bid-ask spread, trading volume and volatility are common proxies used for measuring information asymmetry. In consideration of the factors outlined, it is hypothesised that enterprises demonstrating superior ESG performance will encounter diminishing levels of information asymmetry, as evidenced by proxies as bid-ask spread, trading volume and volatility.

Hypothesis : ESG is negatively correlated with information asymmetry.

3 Data

3.1 Sample overview

This study focuses on companies operating on the European financial market, the sample has been obtained by collecting data over the last five years for companies included in the S&P Europe 350 index. The S&P Europe 350 is a stock index of European stocks that measures the performance of 350 leading companies from 16 major developed European markets, covering both eurozone and non-eurozone markets (S&P Global, 2024). In accordance with S&P Global (2024) the index is float-adjusted market capitalization weighted, and it maintains a balanced representation across the 11 Global Industry Classification Standard (GICS) sectors, as illustrated in the Appendix A. The countries included in S&P Europe 350 are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Furthermore, the index comprises the S&P Euro, S&P Euro Plus, and S&P United Kingdom sub-indices and in addition, it is also one of seven indices that constitute the broader S&P Global 1200 index.

3.2 Data overview

3.2.1 Variable description

3.2.1.1 Independent variable

The independent variable in this study is ESG ratings. The ESG data used in this study is collected from Refinitive Eikon. Today there are several different agencies providing ESG ratings to financial markets, however there exists a lack of standardization in how these ratings are calculated leading to discrepancies in scores depending on the agency. Refinitive provides a comprehensive ESG database, covering a wide range of publicly traded companies. The ESG score is measured on a 0 to 100 scale where higher scores indicate stronger ESG performance (LSEG, 2024). In addition to the numerical ESG score, Refinitive Eikon assigns ESG grades ranging from D- (lowest) to A+ (highest). Similar to other rating agencies, Refinitive Eikon bases its score on the three pillars of environmental, social and governance issues, which include 10 categories (LSEG, 2024). Environment is divided into three

categories: emission, resource use and innovation. Social is divided into four categories: workforce, community, human rights and product responsibility and governance into three categories: management, shareholders and CSR strategy. Unlike other rating agencies, Refinitive Eikon includes ESG controversy as a fourth pillar in their final ESG score. The ESG controversy pillar aggregates controversies across all 10 subcategories into one category score. This allows for a comprehensive ESG score covering multiple bases (LSEG, 2024).

3.2.1.2 Dependent variable

Information asymmetry is a well-known occurrence in financial markets, and the term was disseminated extensively by Akerlof (1970) following the publication of his seminal article, 'The Market for Lemons'. The phenomenon occurs when some market participants have access to more information than others, resulting in information disparities that lead to inefficiencies in the market. Because there is no concrete measure for information asymmetry this study relies on the bid-ask spread, trading volume and volatility to proxy for information asymmetry.

The bid-ask spread is used as an indicator of market liquidity (CFI, 2025). A narrow spread indicates high liquidity, while a wider spread indicates low liquidity. The bid price is defined as the highest price at which a buyer is willing to purchase a security or asset, and the ask price is defined as the lowest price at which a seller is willing to sell a security or asset (Ganti, 2024). The bid-ask spread, therefore, is the difference between these two prices and is representative of the cost of trading. In accordance with Kanagaretnam et al. (2007) the bid-ask spread (SPREAD) is calculated as followed:

$$SPREAD_{i,t} = (Ask\ price_{i,t} - Bid\ price_{i,t})/((Ask\ price_{i,t} + Bid\ price_{i,t})/2)$$

Trading volume is defined as the total number of shares, contracts or units of a security that are exchanged between buyers and sellers during a specific period, which is typically a trading day (Gurung, 2024). It is a fundamental metric that is indicative of market activity and liquidity. To calculate trading volume, it is necessary to sum up all trades for the security within the specified time period. High trading volumes generally indicate increased market liquidity, easier order execution and potentially significant price movements (Thompson, 2024). Conversely, low volumes may be indicative of diminished market interest, reduced

liquidity, and potentially less reliable price movements. In consistency with Beaver (1968), abnormal trading volume is defined as an atypical increase or decrease in the number of shares traded for a given security in comparison to its standard trading activity. To calculate abnormal trading volume, it is necessary to ascertain the normal or expected trading volume and compare it to the actual volume. To control for skewness and kurtosis within the data, trading volume (TRADEVOL) is calculate in accordance with Chae (2005):

$$Trading\ volume_{i,t} = Log(Trading\ volume_{i,t}/Outstanding_{i,t})$$

In accordance with Van Ness et al. (2001), volatility is defined as the standard deviation of daily stock returns. Elbadry et al. (2015) posit the hypothesis that a positive correlation exists between the volatility of stock returns and the degree of information asymmetry. In accordance with Kim and Park (2023) stock volatility (VOL) is calculated as the following formula and logarithmic returns are employed in order to adhere to the principles of normally distributed assumptions.

$$Stock\ return_{i,t} = Log(Close\ price_{i,t}/Close\ price_{i,t-1})$$

$$Stock\ volatility_{i,t} = \sqrt{((\sum_{t=1} (Stock\ return_{i,t} - average\ stock\ return_{i,t})^2)/(N-1))}$$

3.2.1.3 Control variables

In the context of regression analysis, the use of control variables is important for several significant reasons. Firstly, control variables serve to isolate the true relationship between the independent and dependent variables by accounting for extraneous factors that may influence the outcome, thereby reducing the impact of confounding variables (SPSSABC, 2023). The incorporation of applicable control variables can result in more precise estimates of the relationships between variables. Moreover, control variables serve to eliminate alternative explanations for the observed relationships (SPSSABC, 2023). Consequently, incorporating control variables entails possibilities to formulate more robust and reliable models that more accurately reflect the intricate relationships present in the data under study.

To isolate the effect of ESG performance on information asymmetry, this study includes firm size, return on assets, leverage, analyst coverage and book-to-market ratio as control

variables. These variables have been widely used in prior research on information asymmetry to account for firm-level characteristics that influence trading behavior and market transparency. Firm size and leverage are two control variables prominant in prior literature, studies by Kanagaretnam et al. (2007), Kim and Park (2023) and Landsman et al. (2012) all control for firm size and leverage. Lang and Lundholm (1993) show a positive relationship between firm size and disclosure quality. Following prior research, firm size (SIZE) is computed as the log of total firm assets and leverage (LEV) computed as total liabilities scaled by total assets (Kim and Park, 2023; Landsman et al., 2012). Like Kim and Park (2023) this study includes return on assets (ROA), calculated as the net income before extraordinary items divided by total assets and book-to-market (BM) which is a ratio calculated by dividing the book value of equity by the market value of equity. The study also includes the number of analysts that follow each firm during the years (ANALYST), a control variable used by Landsman et al. (2012).

4 Method

4.1 Research design

This study examines the impact of ESG rating changes on market efficiency, specifically the effect on information asymmetry. The research aims to determine whether ESG ratings influences investors trading behavior and liquidity conditions, thereby providing insight into the role of ESG ratings in financial markets. The study focuses on bid-ask spread, trading volume and volatility as proxies for information asymmetry, three commonly used proxies in previous literature (eg. Glosten and Milgrom, 1985: Khan et al., 2015: Kim and Park, 2023: Elbadry et al., 2015).

The study employs a panel regression model, a well-established empirical approach in finance. The choice of methodology is based on prior literature, Elbadry et al (2015) and Kim and Park (2023), that has implemented both fixed and random effect panel data models when studying bid-ask spread, trading volume and volatility. Like prior researchers, the Hausman test is used to determine whether a fixed effects model or random effects model is more appropriate.

4.2 Data structure

The dataset consists of 352 firms, representing 16 european countries and 11 sectors, observed for all weekdays during years 2020-2024. The key variables included in the dataset are bid-ask spread, trading volume, volatility and ESG score as well as a number of control variables such as firm size, leverage, number of analysts following the firm, return on asset and book-to-market ratio. The full sample is retrieved from Refinitiv Eikon and consists of 473 715 observations. The selection criteria are designed to identify any missing observations and to guarantee that a complete set of data is available for all variables. The finalised dataset consists of 438 260 observations available for the analysis, shown in Appendix B.

4.3 Model specification

$$\mathbf{IA}_{it} = \beta_0 + \beta_1 \mathbf{ESG}_{it} + \beta_2 \mathbf{SIZE}_{it} + \beta_3 \mathbf{LEV}_{it} + \beta_4 \mathbf{ROA}_{it} + \beta_5 \mathbf{ANALYST}_{it} + \beta_6 \mathbf{BM}_{it} + \alpha_i + \epsilon_{it}$$

The dependent variable, denoted IA, is the proxy employed to measure information asymmetry for firm i at time t. In the initial model, the variable for measuring information asymmetry is bid-ask spread, while in the subsequent model, trading volume and in the final model, volatility. These three models, with bid-ask spread, trading volume and volatility as the dependent variable, will be referred to as the IA model in the following sections. The independent variable is the ESG score for firm i at time t. SIZE, LEV, ROA, ANALYST and BM are the control variables for firm i at period t. αi are the firm-specific fixed effects and ϵi,t denotes the error term.

In the IA models, all variables are transformed into an annual average, enabling the study to focus on more persistent market effects by averaging over a period of one year. This is because the effect of daily fluctuations is reduced, enabling the analysis to focus on the underlying relationship between variables. ESG ratings are typically updated annually and reflect persistent firm-level sustainability characteristics. As such, the influence of ESG on market behavior unfolds gradually over time (Kruger, 2015). This delayed response suggests that short-term analyses may not fully capture the impact of ESG factors on trading behavior and therefore reinforces the use of longer observation windows.

4.4 Estimation method

Fixed effects (FE) and random effects (RE) are two commonly used estimation methods in panel data analysis. Each of these approaches is characterised by distinct assumptions, applications, and implications for research.

4.4.1 Fixed vs. random effects

According to Cameron and Trivedi (2005), the fixed effects model (FE) is a statistical framework that addresses the issue of unobserved heterogeneity by assigning each cross-sectional unit an individual intercept that remains constant over time. This approach ensures that all time-variant characteristics of the units, whether observed or unobserved, are taken into account by "absorbing" them into the intercept. Cameron and Trivedi (2005) further

explains that the appeal of utilising the fixed effect model derives from its capacity to employ panel data to ascertain causation under less stringent assumptions. Baltagi (2001) describes how FE focuses on within-unit variation by examining how changes within an entity over time affect the dependent variable. Baltagi (2001) also explains that the advantage of using FE is that the model provides consistent estimates even when individual-specific effects are correlated with explanatory variables.

On the other hand, Cameron and Trivedi (2005) posit that the random effects model (RE) addresses the issue of unobserved heterogeneity as being independently distributed from the regressors. If this assumption holds true, RE becomes a more efficient model compared to FE since RE employs both within-unit and between-unit variation (Baltagi, 2001). Furthermore, Baltagi (2001) explains how RE enables the inclusion of time-invariant variables, which cannot be estimated in an FE model. However, should the assumption of no correlation between individual-specific effects and explanatory variables be violated, the estimates of RE become inconsistent. According to Clark and Litzer (2015), the RE model is capable of making out-of-sample predictions due to its capacity to estimate the underlying distribution of unit effects in the population. In contrast, Clark and Linzer (2015) state that the FE model is unable to make out-of-sample predictions due to the fact that the unit effects for unknown units are, in fact, not known.

4.4.2 Hausman test

The Hausman test is a commonly employed tool for determining the optimal model between FE and RE models. The test assesses the significance of the discrepancy between the coefficient estimates of the three models. In instances where the null hypothesis, which posits the absence of a systematic difference, is refuted, the FE model is favoured due to its capacity to generate consistent estimates, even in scenarios where there is correlation between individual effects and explanatory variables (Cameron and Trivedi, 2005). The Hausman test for all models, using both bid-ask spread, trading volume and volatility as dependent variables, the null hypothesis (random effects) is rejected and thus the FE model is preferred (see Appendix C for full results).

In the IA model, it is not possible to exclude the possibility that unobserved time-invariant characteristics may have an effect on both the independent and dependent variables and

therefore FE is preferred. However, this comes with a downside of the IA model not being able to make any out-of-sample predictions.

4.5 Additional tests and diagnostics

All data was retrieved from Refinitiv Eikon, a well-established and reliable source when gathering financial data. To improve and ensure validity of the statistical analysis, multiple techniques were used in preprocessing steps. All variables were winsorized at the 1st and 99th percentile to help manage outliers. As a second step, the variables were standardized because of their varying original scales, in order to secure comparability. Variables with more extreme values and/or with skewed distributions were log-transformed before standardized.

In fixed effect panel data models the problem of heteroscedasticity can be active since the fixed effects model does not manage variation in the distribution of the error term (Das, 2019). In order to control for heteroskedasticity and prevent erroneous or misleading significance levels, the IA models used clustered standard errors. If autocorrelation is present, the residuals are correlated over time, and once again the hypothesis testing can become misleading (Das, 2019). Stock and Watson (2015) explains that in panel data, variables typically are correlated over time within an entity and the use of clustered standard errors are advantageous in this context since they control, not only for heteroscedasticity, but also for autocorrelation.

Multicollinearity occurs when two or more explanatory variables in a regression model are highly correlated with each other (Stock and Watson, 2015). Multicollinearity in fixed-effects models is less problematic because within-transformation removes time-invariant collinear variables (Das, 2019). In all IA models, the data has been standardized which has been proven to mitigate the effects of multicollinearity. Furthermore, multicollinearity becomes less problematic when using larger datasets as in the IA models. A VIF (Variance Inflation Factor) test was conducted to ensure no or low levels of multicollinearity (see Appendix D for full results). The model shows to be robust to the concern of multicollinearity, with all values being below two. The findings of the test indicate that the variables are not significantly correlated with each other. Consequently, their individual contributions to the regression model can be reliably estimated.

The presence of endogeneity can according to Stock and Watson (2015) lead to inconsistency in coefficients and unreliable results when testing the hypothesis since this phenomenon contradicts one of the main assumptions in regression analysis that the error term must be independent of all the explanatory variables. The fixed effect panel data model, as used in this analysis, manages endogeneity related to non-observed heterogeneity that is constant over time (Das, 2019).

4.6 Limitations

The presence of external factors exerting influence over the sample is a matter that is challenging to account for, yet it should be recognised as a potential limitation of the study. The data used in this study consist of both high frequency data (daily) and low frequency data that is updated on a yearly basis. This temporal mismatch can lead to measurement inconsistencies, as changes in the low frequency variables might not be reflected in short term market indicators therefore potentially biasing the observed relationships and their interpretation. To address this the data is transformed into an annual average to better align. This allows the study to focus on the long-term relationship rather than short-term fluctuations.

Another limitation inherent to the use of the fixed effect model is its specificity to the sample under study. Consequently, it is not possible to generalise the model to the broader population (as would be the case with the use of a random effect model). It is important to consider that the choice of using the FE model is motivated by the existence of previous research which employed comparable hypotheses and methodologies. These findings, derived from diverse geographical and sized samples, are to be regarded as complementary.

5 Result and analysis

5.1 Descriptive statistics

The independent variable, ESG score, is a measure of companies' performance in the areas of environmental, social responsibility, and corporate governance (LSEG, 2024). The investigation into whether higher ESG scores reduce information asymmetry by increasing transparency and improving the information environment is of particular interest. Bid-ask spread is a proxy for information asymmetry, with a wider bid-ask spread indicating higher information asymmetry, as market participants require greater compensation for uncertainty (Elbadry et al., 2015). Trading volume is another proxy for information asymmetry. A high trading volume may be indicative of lower information asymmetry, as it is associated with greater market participation and more efficient dissemination of information (Elbadry et al., 2015). The third proxy used for measuring information asymmetry is volatility. In accordance with Elbadry et al. (2015), a higher degree of volatility is indicative of a higher level of information asymmetry, as larger or speculative price fluctuations are indicative of uncertainty.

The descriptive statistics in table 1 shows values for all variables, dependent, independent and control variables. The values shown are the variables after they have been winsorized at the 1st and 99th percentile. As indicated in the data section of this thesis, the dependent values are displayed in accordance with their respective formulas. The independent variable, ESG, can assume any nominal value between 1 and 100, with higher values corresponding to higher scores. In order to address the issue of skewed data, a natural logarithmic transformation has been implemented to enhance symmetry (normality). This transformation is employed on the control variables of firm size, leverage, and book to market.

When taking a closer look at the values shown for each variable we can see that the mean and median of the different variables differ only slightly. These small differences between mean and median indicates that outliers and extreme values have been successfully controlled for. The biggest difference (in percentage) is volatility with twice as high median compared to mean, followed by the other two dependent variables, trading volume and bid-ask spread. Furthermore, bid-ask spread, trading volume and volatility have lower nominal values

compared to the other variables, which is not surprising given the inherent characteristics of these calculations. It is evident that the median values of all variables are situated close to the midpoint between their minimum and maximum values, thereby indicating a normal distribution.

Table 1 shows that the sample of companies has a wide range of ESG scores with the minimum and maximum being 32.38 and 94.03 respectively. This means that the sample includes companies with an ESG grade of C- to A+ according to the LSEG grading scale (LSEG, 2024).

Table 1. Descriptive Statistics

Variable	Mean	SD	Min	Median	Max
SPREAD	0.0009	0.0015	0.0001	0.0005	0.0107
TRADEVOL	0.0025	0.0020	0.0002	0.0019	0.0119
VOL	0.0002	0.0187	-0.0601	0.0006	0.0558
ESG	73.9039	12.5909	32.3845	75.6639	94.0254
SIZE	24.3734	1.6887	20.7065	24.2604	28.7243
LEV	0.6468	0.4240	0.0058	0.5568	2.0174
ROA	6.7824	7.8153	-11.7757	5.6458	37.6699
ANALYST	18.9962	6.1868	1.0000	20.0000	32.0000
BM	3.0026	1.3411	0.3402	2.9731	7.3389

Note: Table 1 shows the descriptive statistics of the variables used in the regression models with the dependent variables bid-ask spread (SPREAD), trading volume (TRADEVOL) and volatility (VOL). The independent variable ESG score (ESG) takes on a nominal value between 1-100. The control variables firm size (SIZE), leverage (LEV), return on asset (ROA), Analyst coverage (ANALYST) and book-to-market (BM) are also included. SIZE, LEV and BM are all log transformed (natural logarithm) to handle skewness and kurtosis. ROA, LEV and BM are expressed as ratios. All variables are winsorized at the 1st and 99th percentile to control for outliers. Number of observations is 438 260.

5.2 Correlation matrix

Table 2 displays the Pearson correlation coefficient between all the variables used in the analysis and shows how the different variables are correlated with each other. The Pearson correlation matrix only portrays the linear relationships between variables (Berman, 2016). For most of the variables the correlation is non existing to weak positive or negative. Correlation does not necessarily imply causality and thus the existence of a correlation between two variables does not guarantee that one is the cause of the other (Berman, 2016).

For most variables the correlation with the independent variable (ESG) is weak, however size and analyst coverage have a slightly higher, but still moderate, positive correlation of 0.2845 and 0.3831 respectively. The higher correlation between ESG score and firm size is not surprising since previous studies (Drempetic et al. 2020) show that larger companies have higher ESG ratings since they have more resources to provide ESG data. Dhaliwal et al. (2011) also finds a positive correlation between corporate sustainability reporting and analyst coverage which explains the higher level of correlation between the two variables. The negative weak correlation between ESG and bid-ask spread (-0.0395) suggests that firms with higher ESG-scores tend to exhibit narrower spreads, indicative of higher market liquidity. The ESG-score also shows a weak correlation (0.0676) with trading volume, indicating that firms with higher ESG performance may experience marginally higher trading volume. The correlation between ESG and volatility is also weakly negative (-0.0026), indicating that firms with higher ESG performance tend to exhibit lower volatility.

Firm size has been shown to be moderately negatively correlated with bid-ask spread and trading volume, (-0.0488) and (-0.0150) respectively. This is not surprising since both bid-ask spread and trading volume are measures of stock liquidity. Ajina and Habib (2017) explains that larger firms tend to possess a greater proportion of highly liquid stocks, which results in a reduction in transaction costs and, consequently, a corresponding decrease in bid-ask spread. In accordance with the findings of preceding studies, it was hypothesised that a positive correlation would be observed between trading volume and size. According to Weigand (1996) this is due to the premise that larger firms tend to attract a greater number of investors, consequently resulting in a higher trading volume. The moderate negative correlation that was observed was therefore unexpected. One potential explanation for this phenomenon could be

sectoral and stable-growth effects, or as Weigand (1996) explains that the impact of information on financial markets may differ with respect to returns and variances as opposed to the volume of trade. The negative correlation does not automatically imply causality; rather, it reflects the interaction between liquidity, investor activity, and market risk factors, as they relate to firm size. The other variables in the correlation matrix were found to be in line with what has been seen before in previous literature.

Table 2. Correlation Matrix

	SPREAD	TRADEVOL	VOL	ESG	SIZE	LEV	ROA	ANALYST	BM
SPREAD	1.0000								
TRADEVOL	0.0360*	1.0000							
VOL	-0.0012	-0.0385*	1.0000						
ESG	-0.0395*	0.0676*	-0.0026*	1.0000					
SIZE	-0.0488*	-0.0150*	0.0010	0.2845*	1.0000				
LEV	0.0073*	0.0573*	0.0005	0.1780*	0.3717*	1.0000			
ROA	-0.0001	-0.1183*	-0.0011	-0.1493*	-0.2978*	-0.3365*	1.0000		
ANALYST	-0.1578*	0.0493*	-0.0036*	0.3831*	0.1878*	0.1503*	-0.0401*	1.0000	
BM	-0.0229*	-0.0551*	0.0001	-0.0057*	0.2548*	-0.2495*	-0.2495*	-0.0926*	1.0000

*Note: Table 2 shows the Pearson correlation coefficient between the variables used in the regression model. All variables used are standardized prior to analysis. The statistical significance is shown by * $p<0.05$.*

5.3 Regression results

The following section presents the results from the regression analysis. The model of choice, with the Hausman test in consideration, is a fixed effect panel data regression model using firm specific effects. It is anticipated, in accordance with the findings of preceding studies, that a negative correlation will be observed between ESG and information asymmetry,

indicating a negative coefficient for bid-ask spread and volatility and a positive coefficient for trading volume.

5.3.1 Bid-ask spread

Table 3 shows the fixed effect regression model using bid-ask spread as a proxy for IA. The table shows the relationship between firm characteristics and bid-ask spread. The model shows an R^2 value of 0.43 meaning that the model approximately explains 43 percent of the within-firm variation in bid ask spread. The F-test shows high significance (Prob>F=0.000) indicating that the model as a whole is statistically meaningful.

Table 3. Bid-Ask Spread

Variable	Coefficient	Std. Error	t-value
ESG	-0.0293	0.0396	-0.74
LEV	0.0679	0.1128	0.60
SIZE	0.1061	0.1869	0.57
ROA	0.0802	0.0413	1.94*
ANALYST	-0.1455	0.0693	-2.50**
BM	0.1464	0.2160	0.68
R^2	0.43	**Prob > F**	0.0000

*Note: Table 3 shows the regression results for bid-ask spread. The model is estimated on observations converted into annual averages. The model is estimated using a fixed effect model controlling for firm fixed effects. Standard errors are clustered at firm level to account for within firm correlation. The statistical significance is shown by: *** p<0.01, ** p<0.05, * p<0.1.*

The results in table 3 indicate that ESG does not have a statistically significant impact on the bid-ask spread. The results show a low negative coefficient (-0.0293) for ESG score which aligns with the hypothesis that higher ESG-scores reduces the bid-ask spread, however the results also show that this relationship is not statistically significant. The negative coefficient

(narrower spread) is in line with prior studies by Kim and Park (2023) who also found that higher ESG had a statistically significant negative relationship with the bid-ask spread. Even though the negative coefficient indicates that ESG performance has a negative relation with the bid-ask spread (lower IA) the results show statistical insignificance.

Similar to ESG, leverage, firm size and book-to-market are all statistically insignificant. They all show a positive coefficient indicating a positive relationship with bid-ask spread. However the relationship is not significant and thus, no reliable inference can be made. This is also in line with what previous research, Kim and Park (2023), has shown.

In contrast, both ROA and analyst coverage exhibit statistically significant relationships with the bid-ask spread. ROA has a positive coefficient of 0.0802 indicating a positive relationship with bid-ask spread that is significant at a 10% level. This relationship indicates that more profitable firms experience wider bid-ask spreads. This result comes as a surprise and the fact that more profitable firms would have wider spreads is slightly counterintuitive, however earlier study by Kim and Park (2023) also found ROA to have a positive relationship with the bid-ask spread between 2006-2019. On the other hand, analyst coverage demonstrates a negative correlation with the coefficient exhibiting a value of -0.1455 and achieving statistical significance at the 5% level. This suggests that higher levels of analyst coverage are associated with narrower bid-ask spreads and by proxy lower information asymmetry. The negative relationship between information asymmetry and analyst coverage is supported by Landsman et al. (2012) and Healy and Palepu (2001).

5.3.2 Trading volume

Table 4 shows the second fixed effect regression model using trading volume as a proxy for IA. The table shows the relationship between firm characteristics and trading volume. The model shows an R^2 value of 0.82 meaning that the model approximately explains 82 percent of the within-firm variation in trading volume, indicating a relatively strong explanatory power for panel data models. The F-test shows high significance (Prob>F=0.000) indicating that the model as a whole is statistically meaningful.

Table 4. Trading Volume

Variables	Coefficients	Std. Errors	t-value
ESG	-0.1910	0.0464	-4.12***
LEV	0.0936	0.0792	1.18
SIZE	-0.5830	0.3498	-1.67*
ROA	0.0463	0.01963	2.36**
ANALYST	0.2069	0.0549	3.76***
BM	0.2241	0.2469	0.64
R^2	0.82	**Prob > F**	0.0000

*Note: Table 4 shows the regression results for trading volume. The model is estimated on observations converted into annual averages. The model is estimated using a fixed effect model controlling for firm fixed effects. Standard errors are clustered at firm level to account for within firm correlation. The statistical significance is shown by: *** p<0.01, ** p<0.05, * p<0.1.*

Among the independent variables, firm size exhibits strong association with trading volume. Size shows a negative coefficient of -0.5830 which is significant at a 10% level. The negative coefficient indicates that larger firms are associated with lower trading volume. This result is surprising but is in line with results found in prior research by Kim and Park (2023) who also found the size coefficient to be negative in relation to trading volume when using a fixed effect panel regression approach. A reasoning behind this surprising result could have to do with the sample of companies used. This study focuses on companies included in the S&P Europe 350 index which is the 350 largest firms in Europe. Gompers and Metrick (2001) found that larger firms tend to attract more institutional investors. This composition of investors might affect the trading volume of firms. Considering that the negative coefficient aligns with findings from Kim and Park (2023) as well as the characteristics of the sample, the results might be surprising but also reasonable. ROA is significant at the five percent level with a positive coefficient of 0.0463, suggesting that more profitable firms tend to attract

higher trading interest and therefore higher trading volume. The positive relationship between ROA and trading volume observed in our results is consistent with the idea that more profitable firms attract greater investor attention. Fama and French (2015) identify profitability as a key driver of expected returns. As investors seek out firms with superior expected returns, higher profitability may lead to increased trading activity through greater demand for those stocks.

Furthermore, the results show a negative relationship between ESG score and trading volume with a coefficient of -0.1910, significant at the one percent level. This indicates that there is a statistically significant relationship between ESG performance and trading volume, suggesting that firms with higher ESG performance tend to exhibit lower trading volume. This result is surprising but the negative relationship between ESG and trading volume, also found by Kim and Park (2023), indicates that ESG transparency may not decrease information asymmetry.

Analyst coverage shows a positive relationship with trading volume, indicating that greater analyst attention is associated with higher trading volume. This relationship is statistically significant at the 1% level. This aligns with Healy and Palepu (2001), who emphasize the role of financial analysts as a key information intermediaries in capital markets. By increasing the availability and interpretation of firm-specific information, analysts help reduce information asymmetry between firms and investors.

In contrast to the significant results for ESG, ROA, size and analyst coverage, leverage and BM are both statistically insignificant. Both leverage and BM show positive coefficients which indicate that higher leverage and BM increase trading volume. However, due to the lack of statistical significance, there is insufficient evidence to suggest a systematic relationship in the model. As a result, no reliable inference can be made regarding impact of leverage and BM on trading volume.

5.3.3 Volatility

Table 5 shows the last fixed effect regression model using volatility as a proxy for IA. The table shows the relationship between firm characteristics and trading volume. The model shows an R^2 value of 0.23 meaning that the model approximately explains 23 percent of the

within-firm variation in volatility, indicating a relatively low explanatory power for panel data models. The F-test shows high significance (Prob>F=0.000) indicating that the model as a whole is statistically meaningful.

Table 5. Volatility

Variables	Coefficients	Std. Errors	t-value
ESG	-0.0132	0.0050	-2.62***
LEV	-0.0142	0.0074	-1.90*
SIZE	-0.0348	0.0210	-1.66*
ROA	-0.0254	0.0035	-7.15***
ANALYST	-0.0344	0.0067	-5.08***
BM	-0.0676	0.2407	-2.81***
R^2	0.23	**Prob > F**	0.0000

*Note: Table 5 shows the regression results for volatility The model is estimated on observations converted into annual averages. The model is estimated using a fixed effect model controlling for firm fixed effects. Standard errors are clustered at firm level to account for within firm correlation. The statistical significance is shown by: *** p<0.01, ** p<0.05, * p<0.1.*

The volatility model is the only specification in which all included variables are statistically significant at conventional levels, ranging from a one to ten percent significance level. ESG, ROA, analyst coverage, and book-to-market are statistically significant at the 1% level and leverage and size are marginally significant at only the 10 % level. Notably, all coefficients are negative, suggesting that increases in each of these variables are associated with a reduction in volatility. The negative coefficient of size is expected and shows that larger firms tend to see a reduction in their stock return volatility. Larger firms are often more diversified in their operations, operating across different industries or geographic areas. Furthermore, larger firms typically attract more attention from institutional investors, are subject to greater

regulatory scrutiny (Elbadry et al., 2015) and have more resources to dedicate to financial reporting and investor relations (Healy and Palepu, 2001), all of which can contribute to more stable stock performance and reduce uncertainty for market participants.

The negative coefficient shown for leverage is surprising and may appear counterintuitive, as higher debt levels are generally associated with increased financial risk and thus higher volatility. However, this could be due to the nature of our sample (highly capitalized firms). Large-cap firms typically exhibit more stable cash flows, diversified operations, and enhanced access to capital markets (Rajan and Zingales, 1995), which can reduce the cost of debt and make higher leverage more sustainable. These firms may use debt strategically without substantially increasing perceived risk. Additionally, the sample period (2020-2024) includes the covid-19 pandemic during which many firms benefited from governmental support and low interest rates, which may have mitigated the volatility typically associated with higher leverage.

The ESG coefficient is negative, which is expected with regards to previous research. The regression shows a negative relationship of -0.0132 between ESG and volatility. The result is significant on a 1 % level indicating a statistically significant relationship between ESG and volatility, suggesting that a higher ESG rating tends to result in lower volatility. The result that firms with higher ESG performance tend to exhibit lower volatility is consistent with earlier research from Kim and Park (2023) and Elbadry et al. (2015), suggesting that there is a small negative relationship between ESG and information asymmetry.

ROA, analyst coverage and book-to-market are all statistically significant at a 1 % significance level with coefficients of -0.0254, -0.0344 and -0.0676 respectively. The regressions analysis points to higher profitability correlating with lower volatility. The relationship between volatility and ROA has proven to be a complex and multifaceted phenomenon, characterised by a paucity of consensus and a considerable degree of contradictory evidence. This complexity arises from the dynamic nature of market dynamics and other characteristics that are subject to variation. Black (1976) established a correlation between long-term return declines and increased volatility. Campbell and Hentschel (1992) developed a model of volatility feedback mechanisms, thereby demonstrating the propagation of return shocks through volatility expectations. Bae et al. (2004) demonstrated how profitability can be negatively correlated with volatility, especially in the short term. The

negative coefficient for ROA in the regression model is consistent with previous research, using similar methods, made by Kim and Park (2023). The result that greater analyst coverage reduces volatility, is consistent with the fact that improved information dissemination can reduce asymmetry. The regression results also show a negative relationship between BM and volatility, a relationship that in previous research has shown to be varying depending on sample selection. Evidenced by DiCiurcio et al. (2021), a possible explanation for the negative relationship is that value stocks (mature companies with stable cash flows) with high book-to-market ratios, as the majority of our sample, exhibit lower volatility due to less uncertainty on future potential, compared to growth stocks.

6 Discussion

The regression results reveal a negative relationship between ESG and all three applied proxies. Although the observed relationship is negative for all three, only trading volume and volatility are statistically significant. When considered as a whole, the results from the three IA models do not present a uniform view of whether to accept or reject the hypotheses. Nevertheless, a thorough examination of the individual models will facilitate the formulation of a comprehensive explanation and the subsequent drawing of a definitive conclusion. The findings indicate a negative correlation between ESG performance and information asymmetry. However, the absence of significant evidence for all proxies suggests that the correlation may be weaker than the one reported by Kim and Park (2022). However, there are some differences between this study and earlier research, primarily with regard to the market under study.

The negative relationship, shown by the IA model, between ESG performance and trading volume initially appears counterintuitive. Prior research suggests that greater transparency, which is often linked to information asymmetry, should lead to higher trading activity (Kim and Park, 2023; Elbadry et al., 2015). Thus this result appears inconsistent with the hypothesis that ESG reduces information asymmetry. However there are some plausible explanations for why ESG is not shown to be negatively correlated with information asymmetry, when using trading volume as a proxy. First, it is possible that ESG disclosures provide little incremental information within a sample consisting of highly transparent firms. Large-cap firms (which this sample consists of) are in general subject to extensive mandatory disclosure requirements, and therefore ESG information may not significantly enhance transparency and investors' understanding. Moreover, this might lead to investors already possessing sufficient information to make informed decisions and may view ESG initiatives as a redundant or inefficient use of capital. Christensen et al. (2022) and Berg et al. (2022) both find a divergence in ESG ratings between different rating agencies, suggesting that the information being presented is inconsistent. Cho et al. (2013) also show that the nature of ESG disclosures allow firms to be selective in the information they portray to the market. These findings from prior studies may indicate that information from ESG disclosures are inconsistent and might be viewed as untrustworthy by investors. From this perspective, resources allocated to ESG activities could be seen as distracting from more directly value-generating investments,

particularly when the information gains from ESG reporting are perceived as minimal or untrustworthy.

On the contrary, there are some previous researchers that have found that the lower trading volume can be consistent with reduced information asymmetry. Nimalendran (1994) demonstrated that, when transaction costs were taken into account, trading volume could be negatively associated with the degree of informational asymmetry in the market.

The IA model for the bid-ask spread, while not statistically significant, shows a negative coefficient. This negative coefficient suggests that firms with higher ESG performance may experience narrower spreads and, thus, improved market liquidity, which has been statistically proven in prior research. However, from the IA model, used in this thesis, no significant conclusions can be drawn from the effect of ESG on bid-ask spread. The lack of statistical significance may reflect diminishing information content in ESG disclosures, which could be attributed to the divergence in ESG ratings (Berg et al., 2022; Christensen et al., 2013) as discussed before. In this context ESG reports may be seen as supplementary rather than essential, and investors may already possess the information needed to price firms accurately thus limiting the impact of ESG. Additionally, as ESG disclosure becomes more standardized and less voluntary, its signaling power may decline, especially if investors perceive reports as driven by regulatory compliance (Muslu et al., 2019).

The IA model finds a significant negative relationship between ESG performance and return volatility. This suggests that firms with higher ESG scores tend to exhibit more stable stock returns, which is an indicator of reduced information asymmetry. This finding is in line with the hypothesis that ESG is negatively correlated with information asymmetry when using volatility as a proxy. Previous researchers, Elbadry et al. (2015) and Kim and Park (2023), also found a negative correlation between the average volatility of stock returns and the degree of asymmetric information. The negative relationship between return volatility and ESG suggests that strong ESG performance may enhance transparency, thereby reducing uncertainty for investors.

A further nuance lies in the heterogeneity of ESG scores. A firm's ESG score is aggregated across three pillars, environmental, social, and governance which may be valued differently by investors. Van Duuren et al. (2016) finds that professional asset managers value

governance more than environmental and social factors. A firm might score highly in governance but poorly in environmental or social aspect, lowering its overall score despite strength in a dimension investors prioritize. This aggregation can obscure the true informational value of ESG performance and potentially distort observed relationships with market behavior.

As has been established by preceding research, ESG disclosure should, in a semi-strong efficient market, reduce information asymmetry as all the available information should be reflected according to the Efficient Market Hypothesis (Fama, 1970). Nevertheless, as asserted by Berg et al. (2022), it is imperative to acknowledge that ESG data frequently exhibits complexity and inconsistency in measurement. The European Union's increased emphasis on sustainability reporting has resulted in ESG ratings becoming an integral component of investors' decision-making strategies (Hummel & Jobst, 2024) which can be seen as a step in the right direction for establishing consistency in a complex disclosure environment.

ESG disclosure, when viewed through the lens of stakeholder theory (Freeman et al., 2010), has the potential to enhance transparency, legitimacy and investor confidence by reducing uncertainty. Nonetheless, from the standpoint of agency theory (Jenson and Meckling, 1976), ESG reporting can be regarded as a mechanism that supervises managers and fosters accountability. In alignment with this theory, Kim and Park (2023) demonstrated that strong ESG practices are associated with increased transparency in financial disclosures. This, in turn, has been shown to reduce the information gap between insiders and external stakeholders, thereby decreasing information asymmetry. The IA model developed in this thesis, shows some indications that ESG ratings are associated with reduced information asymmetry and thus increased transparency, even if the results are somewhat inconclusive.

In accordance with signaling theory (Connelly et al., 2011), ESG performance may serve as a credible signal of enhanced transparency to the market. By engaging in ESG practices firms can signal to market participants qualities not always evident in traditional financial reporting, potentially increasing trust and transparency in the market. This study suggests a potential negative relationship between firms ESG performance and information asymmetry, this relationship is however not fully conclusive, indicating that the signaling effect of ESG may vary.

This study suggests that ESG has the potential of lowering information asymmetry in European markets evident by the negative relationship between ESG and the proxies used for information asymmetry. This relationship is however not conclusive and is in need of further research.

7 Conclusion

This thesis explores the relationship between the environmental, social, and governance performance and information asymmetry in financial markets. This study focuses on bid-ask spread, trading volume, and volatility as proxies for information asymmetry. Focusing on large-cap European firms, where ESG disclosures and regulatory frameworks are relatively mature (Christensen et al., 2013; Hummel and Jobst, 2024), the analysis captures a setting conducive to identifying the financial effects of ESG transparency. Using a firm-level fixed effect panel regression model, this study controls for time-invariant characteristics such as industry classification, enhancing the robustness of our findings. This approach helps isolate the effect of within-firm changes in ESG performance on information asymmetry, rather than relying on cross-sectional comparisons. Overall the findings suggest that there might be a connection between ESG performance and information asymmetry in European financial markets, as evidenced by the negative relationship with the proxies, but the results are not conclusive.

In conclusion, the findings from the regression models testing the aforementioned hypothesis provide evidence of reduced IA, which corresponds with the results of previous research. The bid-ask spread is found to be insignificantly negative, and the trading volume is found to be significantly negative and the volatility is found to be significantly negative. The findings presented in this study do not reflect the clear relationship that was anticipated. Nevertheless, consistent with extant research, we interpret the aggregate outcomes of our study as an indication that the hypothesis is valid, notwithstanding certain limitations.

It is recommended that future research explore the relationship between ESG performance and information asymmetry further in order to ascertain whether the underlying cause is information driven or dependent on other factors. Another suggestion for future research is to focus on the decomposition of ESG scores in order to assess the relative impact of each of the pillars on market behaviour.

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Appendices

Appendix A

Table A1. Sector weights.

Sectors (GICS)	**Weights**
Financials	23.1%
Industrials	17.9%
Health Care	14.2%
Consumer Staples	10.4%
Consumer Discretionary	8.7%
Information Technology	7.1%
Materials	5.7%
Utilities	4.5%
Energy	4.4%
Communication Services	3.4%
Real Estate	0.7%

Note: Table A1 shows the S&P Europe 350 index sector weights.

Appendix B

Table B1. The dataset

Initial dataset of observations	**473 715**
Missing observations	23 152
Days with no trading volume	12 303
Finalized dataset of observations	**438 260**

Note: Table B1 shows the sample selection procedure

Appendix C

Table C1. Hausman test

Model	**P-value**	**Indication**
Bid-Ask Spread	0.000	Fixed effects
Trading Volume	0.001	Fixed effects
Volatility	0.000	Fixed effects

Note: Table C1 shows the results from the Hausman test together with an indication of the suggested model.

Appendix D

Table D1. VIF

Variables	VIF
ESG	1.25
LEV	1.42
SIZE	1.53
ROA	1.19
ANALYST	1.21
BM	1.29

Note: Table D1 shows the results from the conducted Variance Inflation Factor test.