Stock Market Liquidity and Sustainability

Exploring the effect of ESG performance on liquidity in Brazil's and Germany's stock market

Authors

Kristoffer Svanes

and

Caroline B. Øyaas

Abstract

Over the course of the last decade research on ESG and financial performance has seen tremendous growth, although the research related to ESG and market liquidity has yet to be given substantial attention. In this thesis we examine the relationship between the stock market liquidity of firms listed on Brazil's and Germany's dominant exchanges for the period 2010-2019, and the environmental, social, and governance (ESG) scores (i.e., sustainability scores). A random effects panel regression is applied in the comparison between these two regions, and the marginal effects analysed. We find a curvilinear, along with both a positive and negative linear relationship between firm's sustainability scores and their market liquidity. This relationship is found to be varied for Brazil and Germany, the evidence suggesting that the impact of ESG and the three ESG pillars on market liquidity has regional variations. The Brazilian stock exchange is impacted more by the sustainability variables than that of firms listed on the German exchange, which may result from their regulatory and cultural variations. A moderating effect from firm size on the relationship between the sustainability variables and market liquidity is further shown for both Brazil and Germany. The overall results suggest that smaller firms tend to obtain a greater market liquidity benefit from their sustainability efforts compared to larger firms. Conversely, increases in larger firms governance scores for Brazil, and average and larger sized firms social scores for Germany, adversely impacts their market liquidity. This suggests that investor biases and expectations may influence the overall effect a firm's ESG activities have on their market liquidity.

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AUTHOR(S)		SUPERVISOR: Bashiri Behmiri, Niaz
Candidate number: 2069 …… 2057 ……	Name: Svanes, Kristoffer …… Øyaas, Caroline B. ……	

Preface

This master thesis is a conclusion of our Masters of Science in Business Administration jointly written by two students specialising in Applied Finance at the University of Stavanger Business School. The topic is motivated by the increased popularity in ESG investing, particularly over the last year, in addition to our common interests toward sustainable investments and financial markets. The topic of ESG and market liquidity is found to be highly relevant and particularly interesting for our objective of contributing to an area of research which has previously undergone little study.

This has been a challenging and rewarding process, which has led us on a journey of exasperation and frustration from every failed attempt, but also exhilaration and a sense of accomplishment with the final results. For the excellent insights, inspiration, and encouragement we offer thanks to the invaluable contributions of our supervisor Niaz Bashiri Behmiri. Finally, we would like to give thanks to friends and family that have supported and motivated us along the way.

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Kristoffer Svanes

Caroline B. Øyaas

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1 Introduction

Over the past decades, attentions toward sustainable investing, primarily including considerations of Environment, Social and Governance (ESG) factors in investment activities, have gradually become an ever-present aspect in finance market research (e.g., Cunha & Samanez, 2013; Drempetic et al., 2020; Torre et al., 2020). The substantial increase within financial markets toward the importance of sustainable investing has in part been contributed to the environmental, economic, and social challenges facing the global community, and the growing need to address these issues (Consolandi et al., 2020; Cunha & Samanez, 2013). The recognition given to a firm's ESG activities and the use of non-financial ESG data by institutional and individual investors contribute to their investment decisions (Alquraan et al., 2016; Friede et al., 2015). Furthermore, the international financial market instability seen during the COVID-19 pandemic has accentuated the applicability of non-financial parameters, along with investors concerns regarding ESG issues on firm performance (Broadstock et al., 2021). The views and considerations toward firms' ESG issues combining risk, return, and accountability, are considered in a study by Sultana et al. (2018), as key for both global and national sustainable development.

Within the ESG literature, a majority of research conducted on the subject is centralised around financial performance and investment decisions, providing mixed evidence on the benefits of ESG investments (e.g., Broadstock et al., 2021; Consolandi et al., 2020; Mervelskemper & Streit, 2017). In addition, research on volatility has also gained traction in recent years, indicating both reductions in risk and volatility for firms in industries with high ESG concentrations (e.g., Consolandi et al., 2020; Kumar et al., 2016). Conversely, the field of liquidity remains relatively unstudied in its relation to ESG, despite liquidity being significant in financial markets, promoting versatility (Ng & Rezaee, 2015), and functioning as a "leading indicator of the real economy" (Næs et al., 2011, p. 139). Studies on liquidity and sustainability have examined the relationship between Corporate Social Responsibility (CSR) disclosure and equity liquidity, finding a positive association between the two (e.g., Cormier et al., 2011; Egginton & McBrayer, 2019).

Egginton and McBrayer (2019) found that firms having higher CSR disclosure also realised improvements in their market liquidity. This positive relationship is consistent across the environmental, social, and governance pillars. Further support is provided by Consolandi et al. (2020) in their study on U.S. companies which indicated that ESG ratings consistently impacted firms' equity performance. Similar findings are also provided in the works of Cormier et al. (2011) and Cunha and Samanez (2013). Moreover, companies engaging in ESG activities have

over time been found to gain productivity enhancements due to an improvement in their reputation, risk management, customer loyalty, capital costs savings, and HR-activities (Broadstock et al., 2021; Sultana et al., 2018). Furthermore, the information provided about firms' financial performance, based on ESG factors, has been argued to continue affecting the future evaluations of firms (Sultana et al., 2018).

To the authors' knowledge, an explicit study that examines the extent to which ESG factors influence stock market liquidity (hereafter market liquidity) in both emerging and developed markets has yet to be conducted. Within the limited research conducted on ESG and market liquidity, few have taken a comparative approach between emerging and developed markets. Rather, a singular country or market perspective has been an ubiquitous theme. Moreover, prior ESG literature has predominantly focused on developed markets such as the U.S. and Europe, providing a gap in the extent of knowledge on emerging markets (e.g., Consolandi et al., 2020; Sassen et al., 2016). This thesis therefore aims to study the relationship between overall ESG, the three ESG pillars, and market liquidity for Brazil and Germany. The two countries as geographical areas are selected for three reasons which, from the authors' perspective, make it particularly interesting to study the market liquidity relationship in both an emerging and a developed market.

Firstly, both Brazil and Germany are considered strong economies, each having the largest GDP on their respective continents (World Bank, 2021). Brazil, although being one of the larger world economies, experiences considerable ESG challenges related, amongst others, to social-environmental issues such as labour rights and conditions, salary levels, greenhouse gas emissions, unsatisfactory levels of overall pollution, etc. (Cunha & Samanez, 2013). A country's socio-cultural and institutional characteristics are likely to shape the behavioural considerations made by investors (Rehman et al., 2016). These regional and/or country specific variations in behaviour, bring light to the relevance of the dual market perspective of this thesis. Secondly, although Brazil and Germany are strong economies, the cultures and policies relating to governance practices, in addition to the level of investor confidence in firm operations are dissimilar (Miras-Rodríguez et al., 2015). Thirdly, Brazil and Germany have global market accessibility meaning that both foreign and domestic investors have access to their respective exchange markets through the investors' individual investment platforms (MSCI, 2020).

To investigate the correspondence between the sustainability variables (i.e., the overall ESG score and its three ESG pillar scores) and market liquidity, data is obtained from the independent Refinitiv Eikon Datastream database for the period 2010-2019. Random effects panel

regression models were found to fit our data the best, and therefore, used to assess the hypotheses of this thesis applying three different models. The first model focuses on the linear effect of the sustainability variables on market liquidity, the second on a potential moderating effect from firm size on the relationship between the sustainability variables and market liquidity, and finally a curvilinear effect of the ESG factors were modelled expanding on the two first models. The findings of this thesis suggests that market liquidity is affected by the sustainability variables. Our main results indicate the presence of a positive relationship between the sustainability variables and market liquidity, where increased market liquidity follows increased sustainability scores.

However, the results are nuanced by the presence of both linear and curvilinear sustainability and market liquidity relations. The relationship is for most of the variables shown to be negative at low levels of the sustainability scores. Moreover, the marginal effects were found to be stronger in Brazil relative to Germany, and we relate the effect to variations in investors behavioural biases and regional differences in stakeholder pressure towards firms. We conclude that a firm's sustainability scores has an effect on their market liquidity both in Brazil and Germany, and the relationship is influenced by firm size, which sustainability variable the firm invests in, and the level of investment. The findings provide valuable insight into the relation between firms' sustainability efforts and their market liquidity. The novelty of this paper contributes to the understanding of investors sustainability considerations by examining the long-term relationship between sustainability variables and the market liquidity in both an emerging and a developed market.

The rest of the paper is structured as follows. Section 2 presents the theoretical framework introducing relevant concepts related to sustainability and market liquidity, followed by a review of prior literature and hypothesis development in Section 3. The sample selection and data descriptions are presented in Section 4, whilst section 5 outlines the empirical study describing the research methodology and econometric models. Subsequently, the empirical analysis, with regression and marginal effect results is provided in Section 6 along with a discussion of the findings in light of related theory and literature. Finally, section 7 summarises and concludes the thesis.

2 Theoretical Framework

2.1 Stakeholder Theory

Modern stakeholder theory, based on the works of Freeman (1984), may be thought of as a theory which aims to explain a firm's relation to and behaviour within its external environment. Furthermore, the theory is interested in which stakeholders that may partake in, and which stakeholders that benefit from the outcomes of a firm's internal decision-making processes (Phillips, 2008). The perspective established by Freeman, became an embedded aspect of management and organisational thinking (Mainardes et al., 2012), his framework having a firm-centred perspective with a bidirectional relationship between the firm and its stakeholders (Freeman, 1984). Having an understanding of a firm's dependency on external stakeholders, the broad theoretical construct of the stakeholder theory highlights the interactions between firms and diverse stakeholder groups (Mainardes et al., 2012). The stakeholder theory thereby draws on social sciences within the four areas; economics, ethics, politics and sociology (Mainardes et al., 2012). Moreover, the stakeholder construct encompasses a class of theories which broaden and contribute to the understanding of firm-stakeholder relationships and its relation to firm performance (Jones et al., 2018). This construct makes the theory applicable in managerial decision-making processes, through the incorporation of stakeholder interests by providing a framework and logics for recognition, integration and prioritisation of stakeholder relevancy and interests (Crane & Ruebottom, 2011).

From its emergence in the early 1980s, stakeholder theory has been subject to numerous interpretations and applications in areas such as CSR performance and corporate finance (Mainardes et al., 2012). Freeman, considered a founder of modern stakeholder theory (Berman et al., 1999; Mainardes et al., 2012), defined stakeholders as "any group or individual who can affect or is affected by the achievement of the organisation's objectives" (Freeman, 1984, p. 46), which subsequent stakeholder definitions have built upon. Simply put, if firm's objectives are affected by stakeholders, then stakeholder activities may also affect firm's decisions and performance (Berman et al., 1999). Similarly, the stakeholders well-being would be affected by corporate decisions where the firm's achievement of objectives affect stakeholders (Berman et al., 1999). The breadth and ambiguity arising from Freeman's (1984) stakeholder identification has contributed to the contested use of the stakeholder definition and the conceptualisation of stakeholder terminology (Miles, 2017). Various attributes are emphasised dependent upon the relevancy of context the stakeholder definition aims to serve (Miles, 2017).

As a result, the theory has been applied in the describing and explaining of the concrete

aspects and behaviours firms exhibit. It has further been utilised to research stakeholder orientation, along with managers' thoughts about management and management in practice (Berman et al., 1999; Donaldson & Preston, 1995). These variations in stakeholder identification have prompted works to concretize the concept through the classification of stakeholders. Clarkson (1995) divided the stakeholder definition into two separate groups: (1) primary stakeholders consisting of groups or individuals which have a contractual relation of either an official or formal nature toward the firm and (2) secondary stakeholders consisting of those actors without a contractual relation among them governments, media, societies, the natural environment, and regulators which can be or are influenced or affected by the firm. The primary stakeholder group for Clarkson (1995) has been extended to include environmental groups, suppliers, investors, employees, consumer groups, shareholders, trade associations, amongst others (Donaldson & Preston, 1995; Jones, 1995; Miles, 2017).

Conversely, a typology of stakeholder influence was developed by Frooman (1999) through the application of resource dependence theory towards the firm-stakeholder relationship. Here a division was presented between direct and indirect strategies where direct strategies were applied by stakeholders in cases where firms were resource dependent towards them, and indirect strategies in cases of independence (Frooman, 1999). In a different approach the seminal works of Donaldson and Preston (1995) proposed a taxonomy of three differentiating stakeholder approaches: descriptive, instrumental and normative. The purpose was to narrow the stakeholder scope in terms of moral claims (Donaldson & Preston, 1995). A fundamental aspect of the stakeholder approach, according to Freeman (1984), was the firm's dependency on their stakeholders for long-term survival and cannot exist without their support. Firms operate in a social environment where their resources are controlled by stakeholders (Berman et al., 1999). Stakeholder theory can, therefore, influence the field of sustainability research as a result of its fundamental perspective.

Applying a stakeholder framework in firm operations, underpins a firm's need to show consideration and have obligations towards their various stakeholders balancing their demands, expectations and interests (Fassin, 2012; Frooman, 1999). Accordingly, stakeholder considerations may impact a firm's sustainability efforts due to pressures from both external and internal stakeholders. Researchers have proposed that the integration of sustainability and stakeholder concepts would function as a means for improved understanding of a firm's business and societal relations (e.g., Clarkson, 1995; Donaldson & Preston, 1995; Jones, 1995) . By envisioning the purpose of firms in a different way, the role of stakeholder theory has become an important

advocator of CSR, through the theory's emphasis on the firm-stakeholder relationship and its normative foundation acknowledging the value relevance of various stakeholders (Donaldson & Preston, 1995). This normative foundation encourages ethical behaviour by firms, guiding managerial actions and affirming the need for a relation to stakeholders (Mainardes et al., 2012).

The importance and evolving utilisation of a stakeholder perspective in sustainability research may be attributed to the growing pressures placed on firms from stakeholder groups to ratify their ESG interests in firm operations (Mainardes et al., 2012). Moreover, the theory advocates that when firms pursue their respective economic objectives they are correspondingly responsible for the consequences of the firms (in)actions (Fassin, 2012). The attempts to adapt CSR to the stakeholder framework, induced the development of a broader CSR concept through the inclusion of new categories such as environmental action, reporting transparency and diversity, in order to reflect various stakeholder interests and relations (Lee, 2008). Clarkson (1995) applied a stakeholder framework in his evaluation of Corporate Social Performance (CSP) adapting the model to better suit the field of CSR, arguing for a distinction requirement between stakeholder and social issues. He proposed that applying a framework based on the management of the firm-stakeholder relationship, would contribute to increased efficiency in CSP analysis and evaluation. The author found that a focus on primary stakeholder issues contributed to greater firm value compared to a focus on general societal issues (Clarkson, 1995).

These concepts proposed in stakeholder theory convey the relevance and rationale on a micro-level for managerial activities to consider time and resource investments for addressing the interests of their stakeholders (O'Riordan & Fairbrass, 2014; Phillips, 2008). However, although forming a basis for the importance of a firm-stakeholder relationship, the stakeholder theory lacks an explication of how the stakeholder framework should be implemented in practice, and a method for categorising the significance of various types of firm-stakeholder relationships (Mainardes et al., 2012).

Stakeholder Engagement

Stakeholder theory has been advanced through the use of strategies for managing the demands and interests presented by various stakeholders, which have been modelled as a means to apply stakeholder theory in practice (Frooman, 1999). The strategies guide firm-stakeholder relationships and have been conducive for their CSR responses (Frooman, 1999). Applying strategies for managing stakeholder concerns may aid firms in their decision-making process, avoiding adverse actions by stakeholders (Berman et al., 1999). Stakeholder engagement is

therefore a construct for the practices initiated by firms to facilitate positive stakeholder involvement in firm activities (O'Riordan & Fairbrass, 2014). The firm-stakeholder relationship consists of an ongoing process where both parties are tied together irrespective of their acknowledgement of the fact (Donaldson & Preston, 1995). The stakeholder engagement thereby contributes to firms' CSR approaches by encompassing processes conducive to the establishment, development, and maintenance of stakeholder relationships (O'Riordan & Fairbrass, 2014).

Applying stakeholder engagement to a firm's sustainability practices facilitates their ability to ascertain how stakeholders perceive and evaluate their CSR practices (O'Riordan & Fairbrass, 2014), which in turn may contribute to improvements in firm value. Ng and Rezaee (2015) reported that long-term firm value through the fulfilment of and improvements in a firm's overall reputation, social responsibilities, and environmental conduct, would be enhanced by the inclusion of sustainable accomplishments and activities. This demonstrates that the firm-stakeholder relationship represents a valuable resource for firms, highlighting the importance of stakeholder management and the understanding of stakeholder relationships in a managerial context (Mainardes et al., 2012). Firms with no or inadequate stakeholder engagement strategies may, for instance, incur large economic penalties related to aspects ranging from clean-up costs to loss of consumer confidence and stakeholder investments (Cormier et al., 2011; Sultana et al., 2018). The behaviours and predilections of stakeholders are therefore shown to influence stakeholder actions and sentiments towards a firm.

Jones et al. (2018) demonstrated the irrationality of stakeholder behaviour in such that firms would be punished by stakeholders even if it was impractical or did not serve their own self-interest. Similarly, Preble (2005) reported that losses in capital gains and market shares could be a result of boycotts, tarnished reputations and inauspicious lobbying of governmental officials resulting from a firm's mismanagement of stakeholder interest. Considerations towards the perceptions and behaviours of stakeholders relevant for a firm's financial situation and sustainability practices is therefore elaborated in the following sub-section.

2.2 Behavioural Finance

The prospect of "the rational investor" has long been a key concept of traditional economic theory, where the determinants of preference in investment decisions have been described through the expected utility hypothesis (Szyszka, 2013, p. 9). Through the use of expected utility theory systematic deviations between theoretical predictions of behaviour and decision-making in practice were demonstrated by Kahneman and Tversky (1979). Similarly, behavioural economists

along with other extant research have suggested that a combination of behavioural biases that influence investor decisions are linked to emotions and perceptions such as regret, intuition, overconfidence, levels of reactions to market movements and heuristics (e.g., Barber & Odean, 2001; Rehman et al., 2016). By applying psychology to finance, behavioural finance aims to explain anomalies in the market, and questions the market efficiency hypothesis (Szyszka, 2013). Furthermore, the theory of behavioural finance draws upon the seminal work of Kahneman and Tversky (1979), relating to decision-making under uncertainty, and applies a market model focused on investor irrationality (Szyszka, 2013). This framework of behavioural finance describes behaviours of financial practitioners and the effect from their interactions on capital and financial markets (Alquraan et al., 2016). Moreover, the framework seeks to identify how these psychological factors influence the decision-making process of investors (Alquraan et al., 2016), who are considered the key stakeholders.

Acknowledging the role played by Keynes' "animal spirit" in investors decision-making process and the resulted shaping of financial markets (Sultana et al., 2018, p. 6), behavioural finance gives considerations to the emotional dimensions behind investor motives and the subconscious desires, fears and predilections that drive many of their decisions (see Baker & Nofsinger, 2011; Freeman, 1984; Preble, 2005). Investors have expectations toward the firms, their experiences and the effect of the firm-stakeholder relationship contributes in their evaluation of a firm and their subsequent actions (Mainardes et al., 2012). Hosmer and Kiewitz (2005) asserts that the investors', as key stakeholders, trust and commitment was stimulated by proper moral conduct in managers decision-making processes contributing to investment behaviour advantageous for the firm. The behavioural considerations of investors may thereby contribute to explain firms choices toward ESG concerns when making investment decisions. A seminal paper by Barber and Odean (2001) reported that behavioural choices made by individual investors resulted in sub-par investment performance as a consequence of greater trading frequencies caused by the investors overconfidence or biases. The ESG practices of firms are, therefore, considered important in the development of financial markets, firm liquidity and value amongst other firm performance factors (Cunha & Samanez, 2013).

Certain investor groups have a clear notion of what their investment strategies should exclude based on their own specific inherent value. Investments which follow their inherent beliefs will thereby outweigh the potential corresponding performance loss (Chava, 2014; Sandberg, 2011). The sustainable investors choose to avoid firms which exhibit inadequate performance relating to the ESG dimensions, regardless of whether the firm's inadequate ESG practices resulted in

long-term economic disadvantages (Sandberg, 2011). These investors incorporate ESG factors into their assessments and selection of asset, stocks and firm practices in order to maximise long-term risk-adjusted return (Cunha & Samanez, 2013). Through such action, the investors (in effect) contribute to reform the firm through their investment avoidance in firms with poor ESG performance (Sandberg, 2011). Furthermore, a firm's CSR activities are shown to have an advantageous effect on the firm's reputation (Fassin, 2012), which in turn may contribute to improved capital gains.

Firms with good ESG practices obtain benefits in the form of cost and risk reductions, reputation building, and improved growth, thereby contributing to firm liquidity and investor value (Chen et al., 2007; Cunha & Samanez, 2013). Consequently, investors punish firms which are perceived as unjust or have inappropriate practices. This in turn may adversely affect the firm-stakeholder relationship resulting in strikes, lawsuits, negative sentiments, loss of market shares to competitors, etc. (Freeman, 1984; Jones et al., 2018). The sustainable investors may decide to exclude non-sustainable firms from their investment portfolios or firms operating in industries characterised by sin stocks among them tobacco and fossil fuel. These actions along with decreased investments by investors would presumably be a disservice to firm performance and potentially adversely impact firm share value and market liquidity (Chava, 2014; Næs et al., 2011; Ng & Rezaee, 2015).

The growing concern from investors toward global sustainable development has substantiated the focus on sustainable investing and ESG issues in investment decisions, taking into consideration both financial and non-financial criteria (Cunha & Samanez, 2013). The perspectives of behavioural finance and stakeholder theory, and their interrelation with firms sustainability practices is therefore a concept congruent with the modern firm environment (Baker & Nofsinger, 2011; Crane & Ruebottom, 2011). From stakeholder theory, stakeholders are viewed by the firms as part of their operating environment (Berman et al., 1999). And as the main stakeholders in financial theories, the investors' heuristics, engagement, biases and ethical considerations toward sustainable investing are regarded as essential in examinations of firms' market liquidity.

3 Related Literature and Hypotheses Development

Extant sustainable investment research has aimed to address questions on whether sustainable investments are advantageous and conducive to the achievement of superior monetary values when compared to conventional investments (see e.g., Friede et al., 2015; Torre et al., 2020; Wagner & Blom, 2011). The growing awareness from investors and regulators towards ESG issues in relation to, amongst others, investment decisions, corporate strategies, and longevity of firms, has contributed in spurring the expansion of sustainable investment research (Consolandi et al., 2020; Miralles-Quirós et al., 2018; Torre et al., 2020). The implications of sustainability and its relationship on financial markets, corporate health, and performance have undergone much academic debate, as demonstrated by Fiskerstrand et al. (2020) and Friede et al. (2015). These contrasting results provide little conclusive evidence for establishing a consensus on a specific type ESG-Firm performance relationship. Sampling procedures, time span, and regional, industrial and variable characteristics along with varieties in type of method applied, may be contributing factors for the varying results and lack of consensus.

3.1 ESG investing and Firm performance

The majority of sustainable investment research has focused on the relationship between ESG and financial performance, and comparative analyses between sustainable indices and general market indices (e.g., Friede et al., 2015; Rehman et al., 2016; Sultana et al., 2018). A meta-analysis by Friede et al. (2015), examining approximately 2,000 empirical studies spanning a 45-year period (1970-2015), reported that in 90% of the studies a non-negative relationship was presented between ESG and financial performance. Thus, the majority observed a positive or neutral relationship. Torre et al. (2020) examined the effect of ESG factors on stock returns by applying a fixed effects and a random effects model to a panel of 46 firms listed on the Eurostoxx50 index between 2010 to 2018. Little evidence of ESG commitment affecting the performance of Eurostoxx50 firm's was observed, suggesting a neutral relationship. However, they found a small portion of the firms included on the ESG index as having a minimal positive impact on returns (Torre et al., 2020).

Consistent with the bidirectional nature presented in Torre et al. (2020), Wagner and Blom (2011) showed the association of a firm's current performance level and the implementation of ESG factors. Wagner and Blom (2011) reported that a financially well-performing firm would have a positive relationship between their ESG and financial performance, whilst firms already performing poorly would not. These results highlight the complexity and dynamics involved

in ESG research. Contrary to evidence suggesting a positive relationship, the results from a rolling regression used by Fiskerstrand et al. (2020) to analyse ESG portfolios based on the Carhart multi-factor performance model, showed no presence of a relationship between ESG ratings and Norwegian stock returns for 2009-2018.

Extending sustainability research toward the concept of volatility, Kumar et al. (2016) developed an ESG risk-premium model specifically designed to establish stock return volatility and ESG performance correlation. They argued that firms incorporation of ESG factors reduced financial risk and contributed to higher risk-adjusted returns. Kumar et al. (2016) demonstrated that stock performance with reduced volatility and greater returns, was generated by firms that had incorporated ESG into their operations. In a similar vein, Harjoto et al. (2017) applied a path analysis in their examination of institutional ownerships' moderating effect on the CSR and stock return volatility relationship. Their findings indicated that stock return volatility had a gradual reduction in correspondence to "its effects on institutional ownership" when firms increased their CSR practices (Harjoto et al., 2017, p. 99).

3.2 Environmental, Social and Governance factors, and Firm performance

The following section separates the ESG score into its three main pillars; environment, social and governance. These pillars, which a firm's ESG performance is based on, may contribute differently depending upon, amongst others, the firm, region, industry, and time aspects. Establishing the degree to which each of the pillars contribute to a firm's overall ESG performance, may contribute to correct resource utilisation by firms and improve understanding of their operating environment.

Examining the three ESG pillars, Ng and Rezaee (2015) used the KLD database and a panel OLS on a sample of approximately 3,000 firms during the period 1990-2013. Their findings suggested the presence of a negative relation between a firm's cost of equity and their environmental and governance performance. These findings indicate that environmental and governance performance contribute to reductions in cost of capital. Moreover, Ng and Rezaee (2015) also reported a marginal positive cost of equity and social performance relationship for the firms in their sample. Friede et al. (2015), further supports the marginal social performance relationship demonstrated by Ng and Rezaee (2015). However, Friede et al.'s (2015) meta-analysis identified a larger portion of empirical studies with a positive relation between firm- and social performance, than with a negative relation. In addition, the empirical studies included in their analysis identified a similar portion of positive and negative relationships between financial

performance and corporate governance. A positive financial performance and environmental performance relationship is also provided by Friede et al. (2015), reporting that the majority of empirical studies in their meta-analysis indicated a positive firm-environmental relationship.

Dowell et al. (2000) examined the market value implications of global environmental standards applying estimates of Tobin's Q as a measure for market value to a sample of 98 firms from 1994 to 1997. Their study provided evidence in support of environmental performance having a positive effect on firm value. Similarly, the empirical work of Miralles-Quirós et al. (2018) exhibited a positive and significant value consideration from the market in favour of firms' environmental performance where these firms operated in industries which were non-environmentally sensitive. Miralles-Quirós et al. (2018) examined the value relevance of CSR, with ESG as a proxy, for firms on the São Paulo stock exchange from 2010-2015, applying a modified Ohlson's asset valuation accounting model. Their results indicated that industries which were environmentally sensitive have social and governance practices that were valued positively and significantly by Brazil's market. The authors argued that investors could influence firms' CSR strategies, and that investor confidence in firms' CSR information was related to increased equity share value (Miralles-Quirós et al., 2018). Within the social dimension of ESG, Huselid (1995) studied the interrelation between human resource (HR) management and firm performance. Utilising approximately 1,000 U.S. firms from various industries, Huselid (1995) identified a significant impact from firms' HR practices on both long-term and short-term financial performance, along with employee productivity. He argued that good HR management practices could be contributory for gaining competitive advantages.

The empirical works of Mervelskemper and Streit (2017) studied firms' strategy effectiveness and the value assigned to ESG performance by capital market investors. Applying Ohlson's valuation model on a sample from 2010-2014, Mervelskemper and Streit (2017) demonstrated that market value for firms which provided ESG reports, was positively related to the firm's governance, social and environmental performance. For governance performance, this relationship was shown to be insignificant for non-ESG reporting firms (Mervelskemper & Streit, 2017). This is in agreement with Sassen et al. (2016) who reported no significant evidence of a relationship between a firm's governance performance and firm risk in European firms, thereby having limited potential for contributing to improved firm value. Using a large European panel data of 8,752 observations over 12 years, they examined the effects of ESG factors on 1) the risk in European firms and 2) the total risk reflecting the volatility of firms' stocks. Sassen et al. (2016) suggested that improvements in Corporate Social Performance (CSP) through reductions

in firm risk could be advantageous for the overall firm value. Indications towards the interconnection between high public visibility and firm reputation influencing ESG factors impact on total stock volatility were also exhibited.

3.3 Hypotheses development

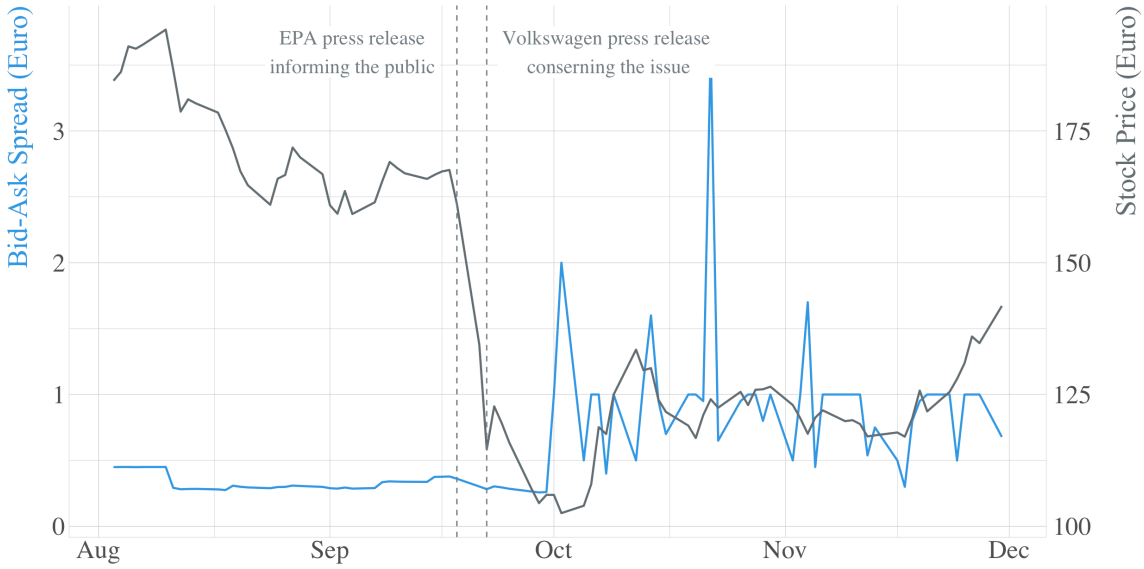
Although being an important feature of financial markets, few studies have examined the effects of sustainable investing on market liquidity. Previous research on the topic has focused on CSR/ESG disclosure by firms (e.g., Chen et al., 2007; Cormier et al., 2011; Egginton & McBrayer, 2019). Examining the relationship between market liquidity and the business cycle of U.S. and Norwegian firms, Næs et al. (2011) documented that market liquidity measures contained "leading information about the real economy" (p.139). This thesis aims to extend the limited ESG research within the liquidity perspective due to the increasing importance of sustainable investments in financial markets and the market features of liquidity. An additional contribution of this thesis stems from the inclusion of both emerging and developed markets, broadening its scope and applicability.

Through regression analysis Egginton and McBrayer (2019) applied a panel over a nine-year period with a sample consisting of 3,500 firms collected from Bloomberg for the purpose of researching the relationship between CSR disclosure and equity market liquidity. The study provided evidence that information asymmetry reduced with the increase in CSR disclosure transparency thereby, improving the equity market liquidity (Egginton & McBrayer, 2019). The authors further suggested that firms with less transparent CSR disclosure strategies benefit greater from CSR disclosure improvements and have more pronounced impacts on market liquidity. In a similar vein, Cormier et al. (2011) demonstrated that reductions in informational asymmetry provided a lower stock price volatility and bid-ask spread resulting from the social and environmental disclosure by Canadian firms. Moreover, descriptive evidence of a relationship between ESG issues and market liquidity is indicated from the graphical representation provided in Figure 1 of Volkswagen's (VW) stock during the DieselGate scandal in 2015, where investors reacted to VW's environmental and governance practices. When the public was made aware of VW's fraudulent behaviour for circumventing emission tests, it instigated a sharp decline in their stock price. The previously stable market liquidity, measured through quoted bid-ask spread, spiked during this time, becoming more volatile before stabilising during the start of 2016.

Figure 1

Volkswagen's Dieselgate Scandal's effect on market liquidity

Figure 1 illustrates how Volkswagen's Dieselgate scandal in 2015 effected their quoted bid-ask spread in the market. The time of the U.S. Environmental Protection Agency (EPA) press release concerning the issue is marked with a dotted line in the graph (EPA, 2015). In the same manner Volkswagen's own press response to the EPA is marked with a dotted line (Volkswagen, 2015).



Note. The graph was created using R software and the data used obtained from the Refinitiv Eikon Datastream.

The mixed empirical findings, behavioural finance theory and the expectations of stakeholders, indicating that firm engagement in sustainability practices likely contribute to long-term superior performance (e.g., Freeman, 1984; Jones, 1995), suggest the presence of a curvilinear relationship between firm performance and their sustainability efforts. Examining the cost of capital impact resulting from the environmental profile of firms between 1992 to 2007, Chava (2014) discovered that firms exhibiting profiles with greater environmental considerations had lower levels of institutional ownership and were issued loans at higher interest rates by lenders. Furthermore, the authors suggested that the environmental externalities may be internalised by firms due to the exclusory investing and lending practices towards non-environmentally friendly firms (Chava, 2014). Taking into consideration the presence of non-linearity, Harjoto et al. (2017) examined the CSR and institutional ownership relation, reporting institutional ownerships as being an inverse U-shape (concave) of CSR. The authors found that once the level of CSR activity was perceived by the institutional investors to have moved beyond an optimal

point, then adjustments were made in their ownership percentage due to the continued increase in the firm's costs from CSR activities. Congruent with the directional shape found by Harjoto et al. (2017), research by Wagner and Blom (2011) on sustainability and financial performance reported a non-linear effect (inverted U-shape) of ESG on financially well- and poor-performing firms.

In contrast, a concurrent paper by Trumpp and Günther (2017) reported that when firms had low Corporate Environmental Performance (CEP) then the relationship between their Corporate Financial Performance (CFP) and CEP was negative. However, the relationship turned positive at higher levels of CEP. Their findings may suggest that sufficient investments into a firm's sustainable activities would be required before obtaining positive performance benefits. This implies that the relationship between sustainability practices and firm performance is U-shaped. Along a similar vein, Nuber et al. (2019) found evidence of a U-shaped relationship in their study of sustainability and financial performance for German firms between 2008-2017. The authors suggested that managers, who aimed to increase the firm's financial performance, should actively increase their sustainability levels in order to accommodate the requirements of investors and other relevant stakeholders. Another study by Wang et al. (2016) argued that the curvilinear U-shape better captured the CSP-CFP relationship. The authors maintained that financial benefits were only obtained from the firm's social activities once an inflection point was passed (i.e., when the costs related to CSP were offset by the financial benefits).

Examining the relationship between financial performance and social responsibility for an unbalanced panel of 61 socially responsible funds, Barnett and Salomon (2006) found this relationship to be curvilinear (U-shaped). They suggested that as the level of diversification, based on social responsibility standards grew, so did the potential for improving risk-adjusted returns. However, the increasing social standards in the fund's stock selections restricts its investment opportunities, thus reducing its diversification potential (Barnett & Salomon, 2006). It is therefore expected that when the scores of the sustainability variables are low, then they would negatively affect market liquidity. When firms increase their sustainability scores a positive effect on firms performance emerges. The following hypothesis is suggested in response to the empirical and descriptive evidence for testing the curvilinearity effect of overall ESG and the ESG pillar scores:

Hypothesis 1 (H1). *The effect of overall ESG and ESG pillar scores on the market liquidity of Brazil and Germany is curvilinear (U-shaped), as at low levels of these scores there is a negative effect that turns to be positive when the level of these scores are higher.*

Existing research on sustainability and firm performance has indicated the presence of firm size effects and the effect firm attributes have on sustainability engagement (e.g., Lin et al., 2019). We therefore, find it relevant to examine the potential presence of an interactive effect from firm size. A recent study performed by Drempetic et al. (2020) containing a data sample of 3,828 firms over an 11-year period using a linear mixed-effects model, found that ESG scores were significantly influenced by the size of a firm. Evidence from their study suggested that a positive correlation existed between a firm's size and their resource capabilities for ESG practices along with ESG reporting. The moderating effect of firm size was further examined by Hernández et al. (2019). Their results indicated the presence of a moderating effect from firm size on the relationship between CSR and economic performance, strengthening along with firm size. Conversely, Lin et al. (2019) examined the relevancy of firm size for Green Innovation (GI) on CFP. Their results indicated the presence of a negative moderating effect between GI and CFP. Therefore, as the size of the firm grew, the weaker the moderating effect of GI became on CFP. Lin et al. (2019) further asserted that preferences in firms decision-making and their perceptions towards sustainable activities were influenced by firm size. This resulted from the high investment costs and greater attention from stakeholders on the actions of larger firms, making them frequently referenced and distinctive (Lin et al., 2019).

Similar evidence was reported by Lee (2008), who maintained that small and medium sized firms had a higher economic orientation. As a result, these firms were less likely to voluntarily invest in expensive environmental technology either due to the lack of resources or in the absence of institutional pressure. Comparatively to larger firms, which in such regard experience greater stakeholder pressure to operate sustainably and legitimise their efforts, the market liquidity of smaller firms, experiencing lower external pressure, would benefit more from their sustainability efforts (Lee, 2008; Mainardes et al., 2012). The size of the firm is, therefore, shown to be related to its resource availability and investor awareness, which in turn may influence firms willingness to engage in ESG activities. The higher expectation towards larger firms to engage in ESG related activities may thereby lead to less pronounced market reactions affecting their market liquidity. To test the interactive effect of firm size and the overall ESG and ESG pillar scores on market liquidity for Brazil and Germany, the following hypothesis is developed:

Hypothesis 2 (H2). *Firm size negatively moderates the relationship between the overall ESG and ESG pillar scores, and market liquidity of Brazil and Germany.*

A dominant portion of research on ESG and firm performance has been limited to European and U.S. markets (see e.g., Friede et al., 2015; Kumar et al., 2016). However, Ma et al. (2016) argued that the effects of market liquidity may be more pronounced in emerging markets resulting from the relative scarcity in firm liquidity. The authors demonstrated that developed markets had lower market illiquidity premiums resulting from a greater transparency and governance structures. From behavioural theory, it may be argued that the institutional and cultural environment influences the impact ESG investments have on market performance. This assertion is consistent with findings by Friede et al. (2015) who identified a higher degree of positive relations between ESG and financial performance for studies in emerging markets compared to those of developed markets. Congruent with this line of thinking, Miras-Rodríguez et al. (2015) studied national cultural effects on the relationship between ESG and financial performance. They suggested that the regional differences in performance were attributed to cultural variations. Miras-Rodríguez et al. (2015) reported a positive correlation between ESG scores and financial performance for cultures that were more future and human oriented, in addition to a higher degree of institutional collectivism.

Cunha and Samanez (2013) conducted a performance analysis of Brazil's stock market, comparing sectoral indices and a benchmark with the corporate sustainability index over a five-year period. Their findings suggested that sustainable investments contributed to increased market liquidity whilst also reducing diversifiable risk. Examining corporate governance and equity liquidity of firms on the SP500 index, Chen et al. (2007) provided empirical evidence of market liquidity being better for firms demonstrating good governance practices. Their findings suggested that reduced equity liquidity and increased costs from liquidity providers were associated with a firm's poor governance practices. Sultana et al. (2018) reported that responsible environmental and social practices had a higher occurrence in firms where the governance practices were more efficient. Applying the sequential mixed method, Sultana et al. (2018) provided empirical evidence that stock market investors in Bangladesh were inclined toward ESG investing. They found that governance issues were prioritised higher compared to social and environmental issues, suggesting that standard corporate governance practices were perceived by investors as providing improved sustainable and financial performance over time in emerging markets. A hypothesis is therefore designed to test the degree of impact from environmental, social, and governance for emerging and developed markets.

Hypothesis 3 (H3). *The three ESG pillars impact Brazil's market liquidity to a greater extent relative to Germany's market liquidity.*

4 Data

The following section is divided into three subsections; (4.1) data collection and sampling procedure, (4.2) definition of variables describing the choice of dependent, explanatory, control, and dummy variables, and (4.3) descriptive statistics including descriptive, correlation, and variance inflation factor (VIF) tables. This study uses the ESG and three ESG pillar scores; environment (henceforth, Environ), social and governance (henceforth, Govern) scores, market liquidity measures, and firm characteristics data for Brazil and Germany.

4.1 Data collection and sampling procedure

All the applied data for this study is collected from the Refinitiv Eikon Datastream database[1], with the exception of the government bond yield data which was obtained from the European central bank (ECB, 2021) and Federal reserve bank (FED, 2021) websites. Datastream covers all firms, independent of industry, listed on the respective stock exchanges reducing the risk of sample selection bias. However, there exists a higher propensity from larger firms to report on ESG issues (e.g., provide ESG reports) contributing to a higher portion of large firms in the data. This in turn increases the risk of large cap selection biases. In addition, as all ESG, market liquidity, and control variables are collected from the same source, there is a potential for an effect from common method bias.

The panel data was screened in order to acquire a relevant sample with accurate and complete firm data. The sample includes observations from firms for the period 2010–2019 using the following sample selection procedure.

- Considering the varied regional criteria within each country for firm inclusion on exchanges only the firms listed on the dominant stock exchange for the respective countries were included in the sample; Xetra and São Paulo.
- The securities are restricted to common shares over the entire sample period for the purpose of sample homogeneity following Næs et al. (2011).
- Firms are at a minimum required to have ESG and all three ESG pillar scores for the three year period 2017-2019. This ensures that firms which previously reported on ESG activities but no longer provide ESG information and/or firms which just recently implemented

[1] Refinitiv Eikon Datastream is an independent third-party data source provider which uses publicly available and objective data obtained from annual reports, CSR reports, stock exchange filings, and organisational and news websites, etc.

ESG reporting practices are excluded from the sample. Moreover it ensures a relatively stable firm count throughout the sample.

The purpose of the screening is to remove the potential for inaccuracies from the sample. Firstly, firms missing complete ESG, Environ, Social, and/or Govern scores for the period 2017-2019 were excluded from the sample. Secondly, the sample is filtered for illogical observations, where the price is below zero or the trading high price of the day is less than the low price. Finally, firm-years with missing data (NA) in excess of 50% per year are filtered out. The authors recognise that the exclusion of firm-years with missing data-points may influence the results potentially contributing to survivorship bias in the sample. The resulting screening provides a sample consisting of 75 firms for Brazil and 94 firms for Germany, corresponding to 603 and 730 observations, respectively.

4.2 Definition of variables

4.2.1 Liquidity Measures

For the purpose of this thesis, market liquidity is set as the dependent variable. The market liquidity data is calculated using daily data averaged to annual frequencies. The aggregation ensures a similar frequency across all variables as the ESG and three ESG pillar scores are restricted to a yearly output in the Datastream ASSET4 database. Several empirical measures have been utilised in previous research to capture market liquidity, among them are the LOT measure, Roll spread estimator, Amihud measure, Zero return measure, high-low spread estimator, turnover, and variations of the bid-ask spread (e.g. Corwin & Schultz, 2012; Lesmond, 2005; Næs et al., 2011). In his (2005) study on liquidity measures in emerging markets Lesmond suggests that turnover may not be a viable liquidity measure for emerging markets as a result of it having no common variation with the Roll, LOT, Aminvest and Amihud measures. Moreover, the nonlinear relationship which is likely to be present between turnover and spread, makes scaling this measure problematic (Lesmond, 2005). In addition, Corwin and Schultz (2012) reports that in comparisons between various markets, the illiquidity measure of Amihud is less suited.

The two measures of market liquidity applied in this paper are therefore the Zero return measure and relative bid-ask spread, as both these measures are not reliant on intraday data. Næs et al. (2011) states that the use of low-frequency market liquidity proxies are prevalent in studies with larger sample sizes and/or time horizons. The Zero return measure accounts for low and zero trade frequencies which are of particular concern for emerging markets. This makes

it relevant for use in Brazil's stock market where zero returns are more common. Furthermore, the frequency of Zero returns for Brazil's stock market make estimations of the LOT measure less reliable (Lesmond, 2005). The Zero return measure is chosen as the primary measure for assessing the influence of ESG and its three pillars on market liquidity. This is due to its applicability for cross-country comparison, and considerations toward low and zero trading frequency. Zero returns measures market liquidity based on the proportion of zero return days in a given month, Eq.A, where high proportions of Zero returns signals lower market liquidity.

$$\text{Zero returns} = \frac{(\text{Number of Zero return days per month})}{(\text{Number of days in corresponding month})} \tag{A}$$

The secondary measure of market liquidity, relative bid-ask spread (spread), is utilised for robustness purposes; Lesmond (2005) reporting that "a high degree of association" (p.422) irrespective of region, is identified between Zero returns and bid-ask spreads. The relative bid-ask spread is a proportional measure of market liquidity simplifying its comparability and understanding, showing a narrow spread as an indication of higher market liquidity. The relative bid-ask spread facilitates cross firm comparisons (Corwin & Schultz, 2012), and is measured using the ask to bid price difference and dividing it by their average as a proxy for the true market price similar to Næs et al. (2011), Eq.B.

$$\text{Relative bid-ask spread} = \frac{(Ask - Bid)}{(Ask + Bid)/2} \tag{B}$$

4.2.2 Sustainability variables

The independent variables considered for this thesis are the ESG and the three ESG pillars (henceforth referred to as the sustainability variables). The scores measure firms' non-financial performance on an annual frequency (Sassen et al., 2016). There are numerous rating agencies which provide performance information for firms sustainability variables such as MSCI, the Asian Sustainability Reporting and KLD. Each use a different rating methodology, as no singular regulatory standard for ESG measurement is currently established (Fiskerstrand et al., 2020; Mervelskemper & Streit, 2017). However, the advantage with ASSET4 is its public and transparent nature allowing scholars deeper insight (Drempetic et al., 2020). The ASSET4 database provides us with objective and comprehensive ESG data with scores normalised between 0 and 100 (Refinitiv, 2021). The characteristics of this database, along with its use in previous research (see e.g., Drempetic et al., 2020; Mervelskemper & Streit, 2017; Sassen et al., 2016), underpins our decision for choosing ASSET4 and the reliability of its use. For interpretation

purposes the scores are divided by 100, a process similarly found in Egginton and McBrayer (2019).

The overall ESG score is composed of a relative sum based on the ESG pillar weights, and reflects the effectiveness, commitment and performance from a firm's ESG efforts (Refinitiv, 2021). The three ESG pillar scores are viewed separately along with the overall ESG score in order to assess the individual pillars effect on the dependent variable. Mervelskemper and Streit (2017) argue that professional investors may value the performance of each pillar differently or find the performance of a given pillar more relevant than the overall ESG score. The three ESG pillar scores are composed of 10 category scores which use underlying Boolean and numeric data points collected using questionnaire surveys (Refinitiv, 2021). The 10 category scores are calculated using a percentile rank scoring methodology based on a set of three factors[2] (Refinitiv, 2021). Firms with higher pillar scores exhibit, in general, a performance in the respective pillar which is greater than firms with lower corresponding pillar scores. In other words, a firm with a high environmental pillar score would have a higher environmental performance. The assertion being similar for the social and governance pillar score.

The environmental pillar score (Environ) is a representation of the firms' effectiveness and commitment toward environmental emission reductions, and the R&D support for products and services which are environmentally friendly (Refinitiv, 2021; Sassen et al., 2016). In addition, the environmental pillar captures the efficiency in firms natural resource usage along with improvements in supply chain management for their production and operational processes (Sassen et al., 2016). The Eviron pillar score is calculated by weighing a firm's average relative rating on the basis of reported environmental information (Refinitiv, 2021). The pillar is composed of the weighted sum from the three main categories' scores; innovation, emissions and resource with weights at 0.30, 0,35 and 0,35, respectively (Refinitiv, 2021).

The social pillar score (Social) expresses a firm's ability to engender trust and loyalty within the society and from their stakeholders (Sassen et al., 2016). The pillar is a measurement of the effectiveness and commitment from management in the creation of value-adding services and products which sustain consumer safety, firm reputation, worker rights, good and safe working conditions in addition to opportunities for advancements within the workplace (Sassen et al., 2016). The Social score is calculated by weighing the firms' average relative rating on the basis of the reported social information such as industry, fair-trade policies, injury rate and

[2]For further elaboration of the three factors and calculation formulas for the 10 category scores please see Refinitiv's (2021) "ESG scores methodology report" which is provided on their homepage.

labour controversies. The Social pillar is composed of the four main categories: workforce, community, human rights, and product responsibility. The weighted sum is calculated from their respective weights; 0.43, 0.28, 0.17 and 0.13 (Refinitiv, 2021).

The governance pillar score (Govern) expresses the systems and processes within a firm, ensuring long-term actions from decision-makers and the board, which are in the best interest of the firm's stakeholders (Sassen et al., 2016). The pillar measures effectiveness and commitment from the firm to maintain best practices in the governance principles. These account for functions and activities of the board such as board structure balance and compensation policies (Sassen et al., 2016). The Govern score weighs a firm's average relative rating on the basis of reported governance information based on the weighted sum of the three categories; management (0.67), shareholders (0.20) and CSR strategy (0.13). The geographic location of the firms' headquarters are used as a benchmark (Refinitiv, 2021).

Accounting for non-linearity of ESG and the individual ESG pillars effects, to see whether there is evidence of curvilinearity, its shape, and pivot point, a quadratic term is included for each panel. In addition, the moderating effect is taken into account to examine whether the strength of the relationship between market liquidity and sustainability variables is affected by the inclusion of firm size as an independent variable. Firm size is selected to test the interaction, given that it, in accordance with literature, may affect firm performance to a greater extent (see e.g. Hernández et al., 2019; Lee, 2008; Lin et al., 2019).

4.2.3 Control variables

Five variables which are known determinants of market liquidity are included in the regression models and averaged from daily to annual. To account for their confounding effects we control for stock price returns (Return), realised volatility of returns (Volatility), annual government bond yields (Yield), logarithm of market capitalisation as a proxy for firm size (Mkt Cap), and logarithm of number of shares traded (Volume). Research on the topic of ESG and market liquidity both account for firm specifics by controlling for firm size (e.g., Egginton & McBrayer, 2019; Fiskerstrand et al., 2020), with logarithm of market capitalisation being a commonly used proxy in investment research (e.g., Drempetic et al., 2020; Fiskerstrand et al., 2020; Ng & Rezaee, 2015). The use of market capitalisation is further seen in research by Egginton and McBrayer (2019), where share price is multiplied by the number of ordinary shares, in order to control for firm complexities. The logarithm of market capitalisation is therefore considered a relevant control variable.

In a similar vein to Egginton and McBrayer (2019), volatility and trading volume are con-

trolled for as a proxy for market uncertainty through the standard deviation of returns, and trading activity through the logarithmic number of shares traded, respectively. Moreover, Chen et al. (2007) suggests that stocks having a higher spread would similarly have a return volatility which is higher. In their study on market liquidity and stock returns, Amihud and Mendelson (1986) maintain that when a stock has a higher bid-ask spread, then higher returns should also be observed. They argue that as bid-ask spreads become higher, a higher expected return should be required by investors in compensation for increased trading costs (Amihud & Mendelson, 1986). The return of stock prices is therefore controlled for. The rationale behind including the 3-month government bond yield is to capture the effect changes in interest rates have on the liquidity in stock markets. Government bond yields influence economies' interest rates affecting investor confidences toward the economy, which in turn impacts market liquidity (Manganelli & Wolswijk, 2009).

4.2.4 Dummy variable

In addition to the control variables, a dummy variable for the oil crisis in 2014 and 2015 (Y14/15) is included in the model to account for the crisis. As the sample includes firms from numerous industries we expect the price of oil to impact firms' operations, which in turn has adverse implications for market liquidity. The value 1 is assigned for 2014 and 2015, all other years are set to 0.

4.3 Descriptive statistics

Table 1 reports descriptive statistics for both Brazil's and Germany's data in Panel A and Panel B, respectively. Spanning over 10-years, the samples consist of 603 and 730 observations for Brazil and Germany, respectively. Im et al.'s (2003) Panel Augmented Dickey Fuller test[3] (i.e., a panel unit root test) shows that all variables are level stationary, requiring no variable transformation. Both liquidity measures show greater average values and volatility in Brazil's stock market relative to the Germany's stock market as indicated by their mean values and standard deviations. This translates to a higher and more stable liquidity situation for Germany relative to Brazil. All the sustainability variables show greater average values for Germany's sample, which could indicate a greater focus on ESG related issues among corporations in Germany as opposed to Brazil. Interestingly, Social score has the highest average value for both

[3]Costantini and Lupi's (2012) Panel Covariate-Augmented Dickey Fuller test was also applied to asses the entirety of both panels, confirming the results from the Im et al. (2003) test.

samples, Environ the lowest average score for Brazil, while Govern has the lowest average score for Germany.

Table 1
Descriptive Statistics

Panels A and B report descriptive statistics for Brazil and Germany, respectively. The ***, ** and * denote statistical significance, respectively, at the 1%, 5% and 10% levels. The Unit Root Test reports W_{tbar} statistic. Variables are stationary when W_{tbar} scores are statistically significant.

Panel A: Brazil						
Statistic	N	Mean	Std. Dev.	Min	Max	Unit Root Test
Zero returns	603	0.092	0.058	0.046	0.616	-10.539^{***}
Spread	603	0.007	0.011	0.001	0.089	-8.084^{***}
ESG	603	0.513	0.217	0.010	0.935	-7.628^{***}
Environ	603	0.461	0.282	0.000	0.940	-7.514^{***}
Social	603	0.545	0.241	0.010	0.969	-8.315^{***}
Govern	603	0.506	0.226	0.007	0.961	-7.988^{***}
Return	603	0.141	0.508	-0.960	5.120	-25.625^{***}
Volatility	603	0.024	0.009	0.011	0.071	-11.114^{***}
Yield	603	0.099	0.026	0.060	0.140	-26.747^{***}
Mkt Cap	603	22.993	1.587	18.007	29.060	-7.614^{***}
Volume	603	13.835	1.942	7.220	17.733	-7.993^{***}
Y14/15	603	0.197	0.398	0.000	1.000	-20.047^{***}
Panel B: Germany						
Statistic	N	Mean	Std. Dev.	Min	Max	Unit Root Test
Zero returns	730	0.037	0.016	0.008	0.194	-21.789^{***}
Spread	730	0.006	0.010	0.001	0.204	-14.042^{***}
ESG	730	0.588	0.211	0.028	0.945	-8.784^{***}
Environ	730	0.551	0.285	0.000	0.983	-8.355^{***}
Social	730	0.635	0.235	0.021	0.981	-8.522^{***}
Govern	730	0.538	0.230	0.019	0.970	-10.101^{***}
Return	730	0.096	0.361	-0.980	2.760	-14.952^{***}
Volatility	730	0.022	0.097	0.004	2.628	-29.447^{***}
Yield	730	0.099	0.026	0.060	0.140	-29.793^{***}
Mkt Cap	730	22.493	1.415	16.943	25.617	-7.884^{***}
Volume	730	8.127	1.526	3.204	12.708	-8.884^{***}
Y14/15	730	0.193	0.395	0.000	1.000	-21.824^{***}

Table 2 reports correlation coefficient matrices for the data on Brazil and Germany, respectively in Panel A and B. The sustainability variables respective scores (hereafter referred to as sustainability scores), are all significantly correlated at high levels with each other, suggesting that multicollinearity could be an issue if they were incorporated into the same model. Therefore, the sustainability variables are estimated in separate models to ensure that no issues with multicollinearity are present. These results are supported by VIF tests, reported in Table 3, for all variables without interaction and quadratic terms. The two measures of market liquidity are

positively correlated at conventional levels, indicating that the robustness check with Spread as dependent variable should have coefficient signs equal to the results of our main analysis with Zero return measure as dependent variable. The sustainability variables are mostly inversely correlated with the Zero return measure and Spread, which suggests that they could have a decreasing effect on Zero return measure and Spread.

Table 2
Correlations

The table provides Pairwise Pearson correlations coefficients for Brazil and Germany in Panel A and B, respectively. The ***, ** and * denote statistical significance, respectively, at the 1%, 5% and 10% levels.

Panel A: Brazil

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Zero returns										
(2) Spread	.62***									
(3) ESG	−.11***	−.06								
(4) Environ	−.20***	−.10**	.85***							
(5) Social	−.11***	−.06	.93***	.78***						
(6) Govern	.03	.01	.75***	.41***	.56***					
(7) Return	.02	−.03	−.03	−.01	−.02	−.05				
(8) Volatility	.35***	.35***	−.13***	−.13***	−.16***	−.01	.05			
(9) Yield	.06	.10***	−.01	.00	−.02	.00	−.20***	.18***		
(10) Mkt Cap	−.08***	−.04	.34***	.30***	.34***	.20***	−.20***	−.11***	−.08*	
(11) Volume	−.30***	−.73***	.17***	.17***	.16	.07*	.15***	−.18***	−.05	.06

Panel B: Germany

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Zero returns										
(2) Spread	.44***									
(3) ESG	.00	−.22***								
(4) Environ	−.05	−.22***	.86***							
(5) Social	.06*	−.15***	.92***	.74***						
(6) Govern	−.05	−.23***	.76***	.47***	.56***					
(7) Return	−.01	−.02	−.02	−.05	.02	−.01				
(8) Volatility	.35***	.74***	−.04	−.07*	.00	−.08**	−.11***			
(9) Yield	−.52***	−.01	−.10***	−.04	−.11***	−.12***	−.02	−.05		
(10) Mkt Cap	−.07**	−.47***	.67***	.64***	.59***	.51***	−.12***	−.15***	−.07**	
(11) Volume	−.25***	−.07**	.19***	.22***	.10***	.21***	−.08**	.06*	.15***	.19***

Table 3
Variance inflation factor tests

The table reports variance inflation factor tests with Zero return measure as the dependent variable for Brazil and Germany in Panel A and B, respectively. The tests report VIF based on all four sustainability variables for both countries in the subsequent Table 4 panels A-D.

Panel A: Brazil				
	ESG	Environment	Social	Governance
ESG	1.605			
Environ		1.651		
Social			1.534	
Govern				1.626
Return	1.526	1.494	1.506	1.509
Volatility	1.371	1.279	1.391	1.346
Yield	1.756	1.740	1.755	1.725
Mkt Cap	2.157	2.775	2.220	2.011
Volume	2.351	2.053	2.259	2.295
Y14/15	1.659	1.641	1.655	1.654
Panel B: Germany				
	ESG	Environment	Social	Governance
ESG	2.002			
Environ		2.001		
Social			1.671	
Govern				1.461
Return	1.189	1.175	1.197	1.136
Volatility	1.334	1.323	1.359	1.263
Yield	1.677	1.660	1.683	1.639
Mkt Cap	2.279	2.193	1.938	1.836
Volume	1.371	1.401	1.358	1.295
Y14/15	1.581	1.586	1.582	1.583

5 Methodology and Econometric models

5.1 Methodology

This thesis applies a multinational panel data, accounting for both time series and cross sectional variations. We apply pooled ordinary least squares (OLS), fixed effects (FE), random effects (RE), and panel generalised method of moments (GMM) methods to estimate our three models. A Lagrange multiplier test is utilised for selection comparison between RE and pooled OLS, which reveals significant panel effects in the data. Pooled OLS is, therefore, less appropriate for panel data as it reduces the validity of the estimation results, hence a RE model is better. To further facilitate the choice of appropriate econometrics approach two Hausman tests were performed comparing RE, FE and panel GMM. The results of the Hausman tests indicate that the RE model was more efficient and thereby preferable to the FE model.

A two-way relationship between the explanatory variables and the dependent variable occurs where endogeneity is present. Consequently, the resulting models will produce biased and inconsistent parameter estimates where causality cannot be inferred. Endogeneity is tested for through the Hausman test comparison between panel GMM and the RE model, providing similar results to the aforementioned. For these reasons, the RE model is considered an appropriate methodological choice for testing the hypotheses. The RE approach allows for estimations of groups and the time-invariant impact on variables by considering individual variable variations in addition to the time dependent variations. Biases from non-observable individual-specific effects are thereby reduced through the use of the RE model. Assuming error independence across groups, White robust standard errors with firm clustering is employed in all model estimations, accounting for serial correlation and heteroskedasticity across clusters of observations.

The variance inflation factor (VIF) is implemented to examine the extent of multicollinearity present in given variables. Results from VIF test below 10 indicate no multicollinearity issues for variables and reduced likelihood of multicollinearity effects on the regression results. To test the significance of interaction and quadratic terms in the model, we run joint significance F tests[4]. Providing a different liquidity measure, a RE estimation using relative bid-ask spread as the dependent variable is performed as a robustness check for reliability purposes. An additional robustness check is carried out using a different estimation method, applying a pooled OLS with the Zero returns measure. All calculations and model estimations are performed using R software.

[4] Where a model includes a stand alone variable and an interaction- or quadratic term created using that variable, the VIF test is not considered appropriate.

5.2 Econometric models

Multivariate regression models are used to test the hypotheses. The three models[5] are applied to each of the sustainability variables for both country samples[6]. The overall ESG score and three ESG pillars scores (i.e., the sustainability scores), will therefore be represented by the explanatory variable notation $x_{i,t}$ in each of the subsequent models. Similarly, for all models the subscript i indicates the cross-sectional dimension, whilst the time series dimension is indicated by the subscript t, and the random effects denoted by $a_{i,t}$. All control variables, return, market capitalisation, volatility, yield, and volume, in addition to the dummy variable, oil price, are captured by $\gamma Controls_{i,t}$. The Zero return liquidity measure, denoted by $Zeros_{i,t}$, represents the dependent variable[7].

5.2.1 Model 1

Model 1 is designed to capture the linear impact of the sustainability variables, control variables, and the dummy variable on the dependent variable following Egginton and McBrayer (2019). In addition, it forms a baseline which is used to examine the effect on the variables' significance when the interaction term and quadratic term are added to the model. Based on the univariate results from Table 2 the sustainability variables are expected to have a negative (positive) effect on Zero returns (market liquidity).

$$Zeros_{i,t} = \alpha_{i,t} + \beta_1 x_{i,t} + \gamma Controls_{i,t} + \varepsilon_{i,t} \tag{1}$$

5.2.2 Model 2

The interaction term, $MktCap \times x_{i,t}$, of firm size and the sustainability variables, $x_{i,t}$, is introduced to examine whether firm size has a moderating effect on the relationship between market liquidity and the sustainability variables: ESG, Environ, Social, and Govern. We expect the moderating effect from firm size to be negative, as the actions of larger firms are presumed to be more visible, and thereby more sensitive to investor decisions than that of smaller firms.

$$Zeros_{i,t} = \alpha_{i,t} + \beta_1 x_{i,t} + \beta_2 MktCap \times x_{i,t} + \gamma Controls_{i,t} + \varepsilon_{i,t} \tag{2}$$

[5] A fourth model was created to explore the curvilinear relationship between market liquidity and the sustainability variables. The results were not significant regardless of country. When included into Model 3 the quadratic term became significant.

[6] Sub-samples before and after 2015 were created to examine the ESG effects post oil crisis along with the effects of increased financing in commodity markets. The results were insignificant and therefore excluded.

[7] The dependent variable is changed to relative bid-ask spread (Spread) in Appendix A.1 when used to model the robustness check with an alternative liquidity measure.

5.2.3 Model 3

Model 3 includes the quadratic term for each of the sustainability variables, denoted by ${x^2}_{i,t}$. The quadratic term is taken into account to explore the potential curvilinear relationships present between the sustainability variables and the dependent variable, in the presence of the interaction effect. This model is used to provide additional validation of the two previous models by accounting for all variables. It also explores whether such an effect is present in terms of the sustainability variables on market liquidity.

$$Zeros_{i,t} = \alpha_{i,t} + \beta_1 x_{i,t} + \beta_2 MktCap \times x_{i,t} + \beta_3 {x^2}_{i,t} + \gamma Controls_{i,t} + \varepsilon_{i,t} \quad (3)$$

6 Empirical Analysis

This section consists of the multivariate regression results, marginal effects for the best fit models identified through the regressions for Brazil and Germany, and an interpretation and discussion of results in reference to the hypotheses.

6.1 Regression results

Multivariate regression results, with Zero return measure as dependent variable, are reported in Table 4, with four panels A, B, C and D, corresponding to the sustainability variables ESG, Environ, Social, and Govern, respectively. Model 1 (1) gives the linear effect of the sustainability scores on market liquidity. Model 2 (2) highlights the moderating effect firm size (Mkt Cap) has on the relationship between the scores of the sustainability variables and market liquidity, whilst model 3 (3) showcases their curvilinear relationship as well as the moderating effect of firm size.

The ESG score estimates in panel A, indicate that the best fit model is model 3 for both countries. ESG and quadratic term are negative and statistically significant at the 5% and 1% levels, and 1% and 5% levels respectively for Brazil and Germany. The interaction term with market cap for Brazil and Germany are positive with a statistical significance at the 5% and 1% levels, respectively. Moreover, both have joint significance tests (joint sig. test) statistically significant at the 1% level confirming the models.

The Environ score estimates in panel B, indicate that model 2 is the best fit model for Brazil. The interaction term for model 2 is negative and statistically significant at the 10% level with a joint sig. test statistically significant at the 1% level. For Germany, model 3 is considered the best fit model with Environ and the quadratic term being negative with a statistical significance at the 1% level, whilst the interaction term is positive and statistically significant at the 1% level. Both models have a statistically significant joint sig. test. at the 1% level.

Social score estimates are reported in panel C. Model 3 represents the best fit model for Brazil with Social score and quadratic term negative and statistically significant at the 5% and 10% levels, respectively. Moreover, the interaction term is positive and statistically significant at the 10% level. In addition, the model has a joint sig. test statistically significant at the 1% level. The best fit model for Germany is Model 2. The Social score and interaction term are, respectively, negative and positive with statistical significance at the 1% level. The model joint sig. test is significant at the 1% level.

Govern estimates are presented in panel D, indicating that the best fit model for Brazil is

model 2. Govern score has a negative sign, while the interaction term is positive. Both scores are statistically significant at the 5% level confirmed by a statistically significant joint sig. test. For Germany the best fit model is Model 3. The Govern score and quadratic term are negative and the interaction term positive with statistical significance at the 5% level, underpinned by a joint sig. test statistically significant at the 1% level.

Table 4

Random Effect Regressions: Zero Return Measure

The table reports the results from random effects regression analysis with Zero return measure as the dependent variable. White robust standard errors with firm clustering are reported within parentheses. Joint significance tests include all terms involving the sustainability variables in the respective models. The ***, ** and * denote statistical significance, respectively, at the 1%, 5% and 10% levels. The panels of Brazil and Germany have 603 and 730 observations, respectively. Both the model significance test and joint significance test reports Chi-squared (χ^2) statistics.

Panel A: ESG Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
ESG	-0.036^{***}	-0.510^{**}	-0.495^{**}	-0.002	-0.123^{***}	-0.145^{***}
	(0.013)	(0.245)	(0.241)	(0.002)	(0.040)	(0.042)
Mkt Cap x ESG		0.020^{*}	0.026^{**}		0.005^{***}	0.007^{***}
		(0.011)	(0.011)		(0.002)	(0.002)
ESG ^{2}			-0.156^{***}			-0.023^{**}
			(0.060)			(0.010)
Return	0.001	0.001	0.001	0.002^{*}	0.002^{*}	0.002^{*}
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	2.371^{***}	2.300^{***}	2.218^{***}	0.054^{***}	0.054^{***}	0.054^{***}
	(0.346)	(0.314)	(0.318)	(0.002)	(0.002)	(0.002)
Yield	0.012	0.042	0.039	-0.435^{***}	-0.433^{***}	-0.432^{***}
	(0.097)	(0.095)	(0.096)	(0.020)	(0.019)	(0.019)
Mkt Cap	0.010^{***}	0.001	-0.0003	-0.001^{*}	-0.004^{***}	-0.005^{***}
	(0.003)	(0.005)	(0.005)	(0.0004)	(0.001)	(0.001)
Volume	-0.009^{***}	-0.010^{***}	-0.010^{***}	-0.001^{***}	-0.001^{***}	-0.001^{***}
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	-0.009	-0.009	-0.009	0.016^{***}	0.016^{***}	0.016^{***}
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	-0.034	0.158	0.174	0.102^{***}	0.176^{***}	0.191^{***}
	(0.053)	(0.119)	(0.119)	(0.009)	(0.029)	(0.030)
Adjusted R^2	0.277	0.289	0.281	0.536	0.546	0.549
Model Sig. Test	106.418^{***}	103.500^{***}	133.533^{***}	1665.519^{***}	1647.542^{***}	1660.794^{***}
Joint Sig. Test		21.957^{***}	24.442^{***}		9.317^{***}	13.140^{***}

(Continued)

Table 4 – *Continued*

Panel B: Environmental Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Environ	−0.051***	0.218	0.219	0.0004	−0.097***	−0.131***
	(0.009)	(0.146)	(0.148)	(0.002)	(0.033)	(0.035)
Mkt Cap x Environ		−0.012*	−0.012*		0.004***	0.007***
		(0.006)	(0.007)		(0.002)	(0.002)
Environ ^{2}			0.003			−0.022***
			(0.036)			(0.006)
Return	0.002	0.002	0.001	0.002*	0.002*	0.002*
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	2.333***	2.321***	2.326***	0.054***	0.051***	0.050***
	(0.339)	(0.342)	(0.342)	(0.002)	(0.003)	(0.003)
Yield	0.010	−0.008	−0.008	−0.432***	−0.430***	−0.426***
	(0.096)	(0.095)	(0.096)	(0.019)	(0.019)	(0.019)
Mkt Cap	0.010***	0.013***	0.013***	−0.001**	−0.004***	−0.005***
	(0.003)	(0.004)	(0.004)	(0.0004)	(0.001)	(0.001)
Volume	−0.009***	−0.008***	−0.008***	−0.001***	−0.001***	−0.001***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.009	−0.009	−0.009	0.016***	0.016***	0.016***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	−0.049	−0.125	−0.126	0.105***	0.165***	0.188***
	(0.055)	(0.090)	(0.092)	(0.009)	(0.026)	(0.026)
Adjusted R^2	0.300	0.302	0.300	0.537	0.547	0.555
Model Sig. Test	112.689***	136.510***	144.581***	1709.281***	1548.649***	1452.841***
Joint Sig. Test		34.604***	35.456***		8.479**	18.758***
Panel C: Social Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Social	−0.026**	−0.395*	−0.392*	0.001	−0.125***	−0.134***
	(0.011)	(0.215)	(0.216)	(0.002)	(0.035)	(0.037)
Mkt Cap x Social		0.016*	0.020*		0.006***	0.007***
		(0.009)	(0.010)		(0.002)	(0.002)
Social ^{2}			−0.097**			−0.012
			(0.046)			(0.008)
Return	0.002	0.002	0.001	0.002*	0.002*	0.002*
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	2.344***	2.297***	2.236***	0.054***	0.056***	0.056***
	(0.346)	(0.318)	(0.319)	(0.002)	(0.002)	(0.002)
Yield	0.011	0.028	0.040	−0.431***	−0.429***	−0.427***
	(0.097)	(0.096)	(0.096)	(0.020)	(0.019)	(0.019)
Mkt Cap	0.009***	0.002	0.001	−0.001***	−0.005***	−0.005***
	(0.003)	(0.005)	(0.005)	(0.0004)	(0.001)	(0.001)
Volume	−0.010***	−0.010***	−0.010***	−0.001***	−0.001***	−0.001***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.009	−0.009	−0.009	0.016***	0.016***	0.016***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	−0.027	0.135	0.144	0.106***	0.190***	0.199***
	(0.053)	(0.113)	(0.117)	(0.008)	(0.027)	(0.028)
Adjusted R^2	0.280	0.286	0.283	0.538	0.552	0.553
Model Sig. Test	102.845***	99.775***	118.002***	1696.01***	1709.636***	1666.052***
Joint Sig. Test		16.134***	17.907***		14.391***	16.053***

(Continued)

Table 4 – *Continued*

Panel D: Governance Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Govern	−0.002	−0.606**	−0.584**	−0.005***	−0.056*	−0.076**
	(0.011)	(0.241)	(0.250)	(0.002)	(0.034)	(0.037)
Mkt Cap x Govern		0.026**	0.027***		0.002	0.004**
		(0.011)	(0.010)		(0.002)	(0.002)
Govern ^{2}			−0.046			−0.019**
			(0.051)			(0.009)
Return	0.002	0.001	0.001	0.002*	0.002*	0.002*
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	2.403***	2.197***	2.192***	0.054***	0.053***	0.052***
	(0.337)	(0.294)	(0.296)	(0.002)	(0.003)	(0.003)
Yield	0.016	0.058	0.058	−0.439***	−0.437***	−0.439***
	(0.097)	(0.094)	(0.094)	(0.019)	(0.019)	(0.019)
Mkt Cap	0.008***	−0.004	−0.005	−0.001	−0.002*	−0.003**
	(0.002)	(0.005)	(0.005)	(0.0004)	(0.001)	(0.001)
Volume	−0.010***	−0.010***	−0.010***	−0.001***	−0.001***	−0.001***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.009	−0.009	−0.009	0.016***	0.016***	0.016***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	−0.020	0.270**	0.271**	0.099***	0.127***	0.141***
	(0.052)	(0.114)	(0.113)	(0.008)	(0.024)	(0.026)
Adjusted R^2	0.273	0.303	0.298	0.536	0.539	0.542
Model Sig. Test	92.821***	95.261***	119.658***	1498.206***	1311.858***	1484.313***
Joint Sig. Test		7.898**	10.864**		8.548**	12.043***

Return and Yield are non-significant for Brazil when controlled for in the sustainability models. For Germany, however, Return is positive and Yield negative, being statistically significant at the 10% and 1% levels, respectively, in all panels. With regards to Volatility, all panels show a positive and statistical significance at the 1% level for both Brazil and Germany, while for Volume the statistical significance is negative at the 1% level. The overall regression shows that Mkt Cap is non-significant for Brazil, with the exception of the Environ panel where Mkt Cap is positive and statistically significant at the 1% level. For Germany, Mkt Cap is negative and statistically significant at the 1% level for the ESG, Environ and Social panels, and 5% level for the Govern panel. The dummy variable for oil price, Y14/15, is only statistically significant for Germany, being positive at the 1% level.

6.2 Marginal Effects

The best fit models all include an interaction term. To interpret the results of the regression analysis and effect of the best fit models, the use of marginal effects is required. In the following section the marginal effects of the best fit models from each of the panels for Brazil and Germany are drawn. The marginal effects at mean of the sustainability variables are given in

Table 5. In addition, Figures 2 and 3 depict the marginal effects graphs for Brazil and Germany, respectively. The figures represent the interaction term between the sustainability variables and firm size along with the quadratic term of the sustainability scores. Firms with low, average, or high market capitalisation are, respectively, represented by the 25th quartile (p25), mean, and 75th quartile (p75). Each group is shown with 95% confidence intervals representing the upper and lower bounds for the parameter encompassing the graph lines.

6.2.1 Marginal effects at mean

In order to answer our third hypothesis the marginal effects at mean of the sustainability variables on Zero returns are used and presented in Table 5. The effects are shown to be stronger for Brazil relative to Germany. All effects for Brazil are negative, Environ having the strongest negative effect closely followed by overall ESG. For Germany the effects are diverging with overall ESG having the strongest negative effect and Environ the strongest positive effect. A negative marginal effect at mean on Zero returns translates to a positive market liquidity effect. Therefore, these results move in support of hypothesis 3 (**H3**) showing that the three ESG pillars impact Brazil's market liquidity to a greater extent relative to Germany's market liquidity.

Table 5
Marginal effects at mean
The table reports marginal effects at mean for Brazil and Germany. Estimates are parital derivatives of Zero returns with respect to each of the sustainability variables.

	ESG	Environment	Social	Governance
Brazil	−0.057	−0.058	−0.038	−0.008
Germany	−0.015	0.002	0.001	−0.006

6.2.2 Marginal effects for Brazil

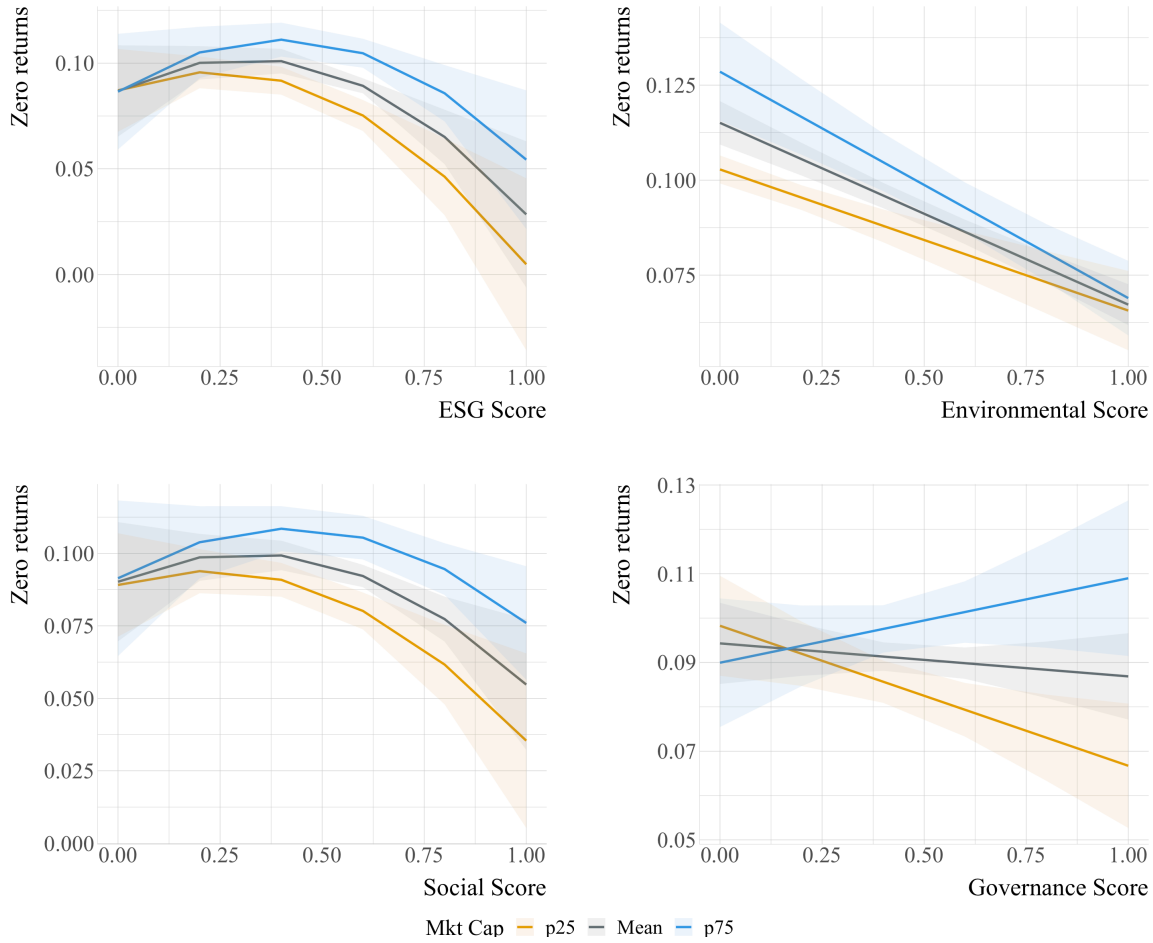
Marginal effects for Brazil are presented in Figure 2. Both ESG and Social score have a concave shape, which indicates an initial positive effect on Zero returns, at a decreasing rate. As the scores increase, a directional change occurs resulting in an increasing negative effect on Zero returns. This holds true for all firms, regardless of firm size, although the effects are more pronounced for larger firms when the effects are positive, and smaller firms when the effects are negative. This shows that at low levels of ESG and Social score, a one unit increase in these scores decreases market liquidity, whereas a one unit increase at high levels increases market liquidity. However, the directional change occurs earlier for smaller firms relative to larger firms. This indicates that the initial negative effect from ESG and Social score on market

liquidity becomes positive earlier for smaller firms when compared to larger firms, suggesting that smaller firms benefit earlier from ESG and Social score increases.

Figure 2

Brazil: Marginal effects of sustainability scores on predicted values of Zero returns

The figure shows marginal effects based on the data from Table 4 for Brazil with predicted Zero returns (market liquidity) on y-axis and the sustainability variables on x-axis corresponding to the four panels in Table 4. Mean represents the average firm, whilst p25 and p75 represent low and high market cap firms, respectively.



The Environ score has a linear downward sloping shape indicating a decreasing effect on Zero returns from increased Environ scores. The effect holds true for all firm sizes, although the effect is more pronounced for firms with higher market capitalisation. This shows that the positive effect of Environ score on market liquidity is greater for larger firms, while all firms' market liquidity will benefit from increases in Environ score.

Govern score has diverging effects depending on firm size. Smaller and average sized firms have a linear downward sloping shape, whereas larger firms have a linear upward sloping shape. The linear downward sloping shape indicates that a one unit increase in Govern score leads to

a negative effect on Zero returns, while the linear upward sloping shape translates to a positive effect on Zero returns. Firms with lower market capitalisation have a stronger negative effect of a one unit increase in Govern score relative to the average sized firms, where the effect is much less pronounced. This means that for small and average sized firms an increase in Govern score increases market liquidity, while for large firms an increase in Govern score decreases market liquidity.

6.2.3 Marginal effects for Germany

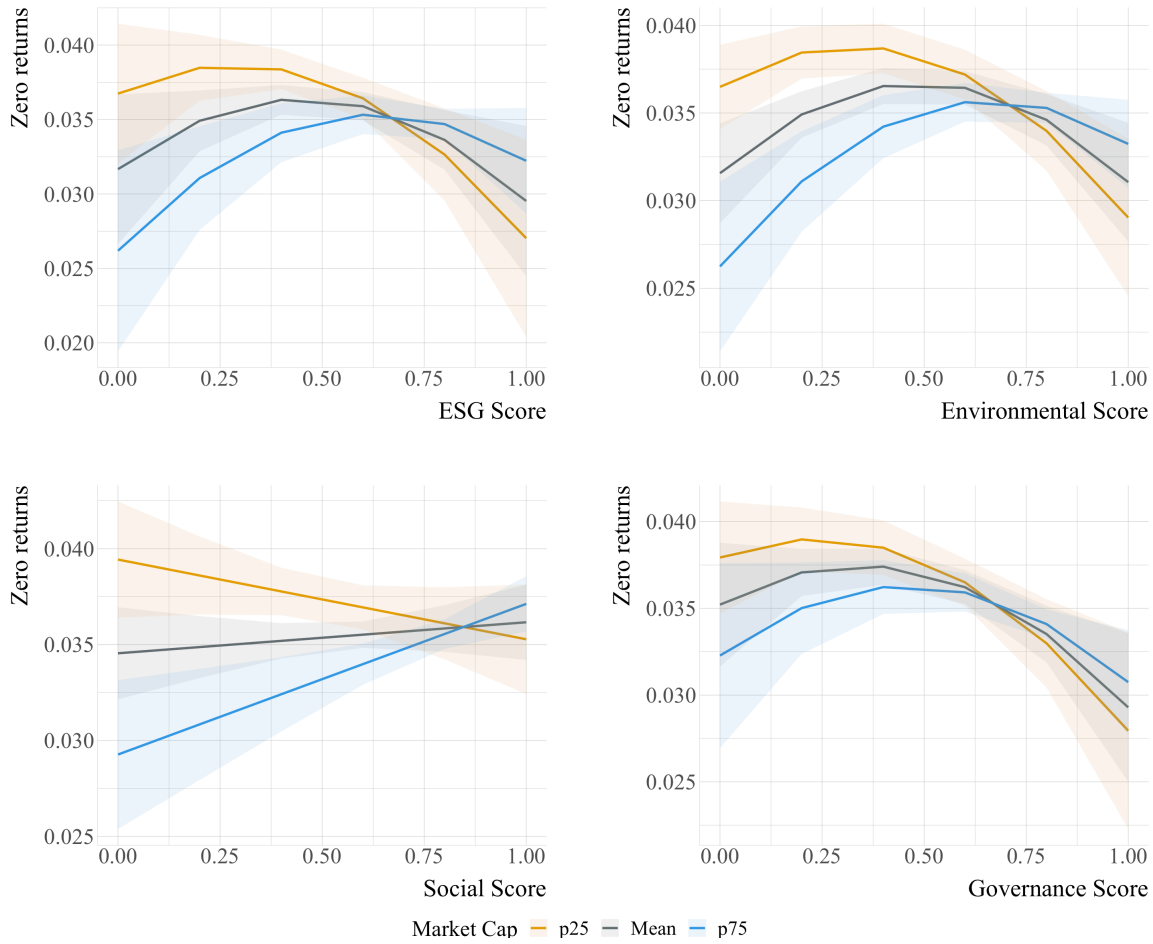
Marginal effects for Germany are depicted in Figure 3. ESG, Environ and Govern scores have concave shapes, which means Zero returns have an initial decreasing positive effect from a one unit increase in these scores at low levels. After the turning point, a one unit increase in these three scores lead to a negative effect on Zero returns, at an increasing rate. For smaller firms the turning point from a positive to a negative effect on Zero returns occurs at an earlier stage than for average and larger firms. This indicates that the change in effect occurs at a later stage as firm size grows. The negative effect on Zero returns is greater for smaller firms relative to average and large firms at high levels of ESG, Environ and Govern scores, whereas at low levels the positive effect on Zero returns is greater for larger firms. The market liquidity implications of these effects are twofold. At low levels an increase in ESG, Environ and Govern scores decreases market liquidity, while at high levels an increase in these scores increases market liquidity. These results suggest that larger firms benefit less from higher ESG, Environ and Govern scores in terms of market liquidity, relative to average and smaller sized firms, with smaller firms achieving the greatest benefit.

Social score has diverging effects depending upon firm size. Larger and average firms have linear upward sloping shapes, where larger firms have a more distinct upward shape relative to average sized firms. Smaller firms have linear downward sloping shapes. The downward sloping shape translates to decreased Zero returns for every unit of Social score increase, while the upward sloping shape indicates an increased Zero return for every unit of increase in Social score. In terms of market liquidity, the linear downward sloping shape translates to increased market liquidity, whereas the linear upward sloping shape means decreased market liquidity. This shows that smaller firms are better off with a high Social score, while average and larger firms seem to benefit from lower Social scores in terms of maximising market liquidity.

Figure 3

Germany: Marginal effects of Sustainability scores on predicted values of Zero returns

The figure shows marginal effects based on the data from Table 4 for Germany with predicted Zero return measure (market liquidity) on y-axis and the sustainability variables on x-axis corresponding to the four panels in Table 4. Mean represents the average firm, whilst p25 and p75 represent low and high market cap firms, respectively.



6.2.4 Consolidating results

The results of Brazil's and Germany's marginal effects in the presence of a curvilinear shape finds that when market liquidity effects are negative, the increases in the sustainability scores contribute to a larger decrease in market liquidity for larger firms relative to average and smaller sized firms. Conversely, when the market liquidity effects turn positive, then an increase in the sustainability scores results in a progressively larger increase in the market liquidity for smaller firms relative to average and larger sized firms. These results indicate that the positive effect on market liquidity only occurs at higher levels of the sustainability scores. Brazil's ESG and Social scores, and Germany's ESG, Environ and Govern scores thereby show that all firms require a given level of investments in these respective variables before the effect on market

liquidity moves from negative to positive. From this it is found that the benefits of increasing the sustainability scores are stronger for smaller firms market liquidity relative to larger firms.

The results of the linear marginal effects for Brazil and Germany are varied. The marginal effects of Environ score on market liquidity in Brazil is positive for all firm sizes when the Environ score increases. Thus, firms' market liquidity benefit from improvements in Environ score. These effects become more pronounced as firm size grows. The Govern and Social score for Brazil and Germany, respectively, show diverging marginal effects on market liquidity. A positive marginal effect on market liquidity is present for smaller firms, whilst a negative marginal effect on market liquidity is found for larger firms. However, the marginal effects on market liquidity for average sized firms differ. A negative marginal effect is found for the Govern score in Brazil, while a positive marginal effect is found for the Social score in Germany.

Based on the insight gained from Figures 2 and 3, we find some support for hypothesis 1 (**H1**). Results from the marginal effects confirm the curvilinear relationship between the sustainability variables and market liquidity. A U-shaped curvilinear relationship on market liquidity is found for Brazil's ESG and Social score, and for Germany's ESG, Environ and Govern score. At low levels of these scores there is a negative effect on market liquidity that turns positive at high levels. These results move in support of **H1**, whilst the linear effects from Environ and Govern score for Brazil, and Social score for Germany are not confirmatory of **H1**.

Hypothesis 2 (**H2**) is partly verified in our results. In general, the moderating effect of firm size on the relationship between market liquidity and the sustainability variables strengthens as firm size decreases. This negative effect holds true for the majority of variables with a linear relationship. However, for the variables with a curvilinear relationship this only holds true at high levels of the sustainability variables, whilst at lower levels the moderating effect strengthens as firm size increases. Furthermore, the moderating effect of firm size on the relationship between Environ score and market liquidity for Brazil is positive, becoming larger with firm size.

The results of the marginal effects at mean substantiates our hypothesis 3 (**H3**). When comparing the results from the two countries it is clear that the market liquidity effect of increases in the sustainability variables are more attractive in Brazil relative to Germany. Both marginal effects at mean and the shape of the marginal effect graphs depict this general trend. Brazil's curvilinear concave graphs seem to have steeper downward shapes at high levels of the sustainability variables relative to the curvilinear concave shapes presented in Germany's graphs.

Testing the robustness of the main results detailed above, two robustness checks are performed, one using an alternative measure for market liquidity and the other an alternative estimation method. Both are found in the Appendix. The alternative market liquidity measure is found in A.1 utilising random effects with relative bid-ask spread (Spread) as represented in Table A.1. A.2 presents the alternative estimation method using pooled OLS with Zero return measure for market liquidity as shown in Table A.2. Both robustness checks utilise the same models for the main regression. The results are mostly comparable for both robustness checks, confirming the main results. ESG score's effect on market liquidity is fully confirmed with Spread as the alternative market liquidity measure. Moreover, the three ESG pillar scores show similar results. The alternative estimation method has estimates closely resembling Germany's main results, whereas Brazil's pooled OLS results are somewhat less confirmatory.

6.3 Discussion

This thesis has sought to extend the literature on sustainable investing by empirically testing the relationship between market liquidity, and the overall ESG and three ESG pillar scores. Exploring this relationship in two distinct financial markets, our work addresses aspects which at present have received modest attention in literature on sustainability. Moreover, few studies have applied both behavioural finance and stakeholder theories when examining the ESG and market liquidity relationship. This thesis, therefore, contributes to both stakeholder theory and behavioural finance theory by highlighting the significance of investors interests in firms ESG activities and market liquidity. A key finding in our study was the presence of both a positive and negative relationship between market liquidity and our sustainability variables, which was dependent upon a firm's degree of investment and the variable they invest in. These results complement existing studies on the topic and aid in the explanation of the competing views found in extant literature on the relationship between ESG and performance.

The results of our marginal effects analyses both contradict and support our initial hypothesis, finding both a linear and curvilinear effect. These findings are therefore somewhat congruent with the linear relation between ESG measures and equity liquidity indicated by Egginton and McBrayer (2019), and the presence of curvilinearity as demonstrated by Barnett and Salomon (2006) and Trumpp and Günther (2017). Unlike the inverted U-shape reported in other studies (see e.g., Harjoto et al., 2017; Wagner & Blom, 2011), we find a U-shaped relationship between the sustainability variables and market liquidity. Our findings, thus, concur with research showing a U-shaped curvilinear relationship (see e.g., Nuber et al., 2019; Wang et al.,

2016). The discrepancies with some extant literature may be related to the method and models used in our study, testing the three ESG pillars individually along with the overall ESG score, and the inclusion of a quadratic term. This thesis thereby demonstrates that the type of relationship is variable dependent and changeable at different levels of sustainability scores. As a result, we propose that the impact from the four sustainability variables conform to the level of investments provided by firms. This is somewhat consistent with previous research and our initial expectations of curvilinearity. Our findings thereby extends the work of Consolandi et al. (2020), who found a relation between improved ESG rating and increased firm equity performance, by showing how a firm's market liquidity is affected by improvements in sustainability ratings.

Considering the existing research demonstrating the varied importance from a stakeholder perspective (see e.g., Jones et al., 2018; Mainardes et al., 2012) and the varied implications on performance from the different sustainability variables (see e.g., Friede et al., 2015; Ng & Rezaee, 2015), our finding are not perceived as particularly hard to reconcile. By acknowledging the bidirectional relationship between market liquidity and the sustainability variables, we propose that this relationship would be dependent upon the investors' behavioural orientation which develops over time. This accounts for the results where a greater investment in general has to be made in the sustainability variables before it benefits the majority, although not all of the firms' market liquidity. A plausible explanation for our results may relate to the biases and expectations investors exhibit toward firms' ESG activities, which vary amongst the three ESG pillars thereby being less predictable. This is consistent with Jones et al. (2018) maintaining that stakeholders rational orientation may account for behaviour which is not predicted.

Sultana et al. (2018) demonstrated the preference variations investors have toward the ESG pillars, finding that issues related to governance were prioritised higher than those of social and environmental. Miralles-Quirós et al. (2018) similarly demonstrates the influence of investors' predilections when comparing environmentally sensitive and non-sensitive industries. As the main stakeholders in financial theories, investors' heuristics, engagement, biases and ethical considerations toward sustainable investing are, therefore, regarded as a relevant aspect for firms' market liquidity. From this we argue that the inclusion of stakeholder concerns contributes valuable insights into the responses of investors to firms' ESG actions and achieved market liquidity. The aspects of stakeholder theory which argues that a firm's socially oriented characteristics may lead to better financial performance (e.g., Barnett & Salomon, 2006; Nuber et al., 2019), are congruent with our assertion.

Extant research has debated the degree to which size, as a firm characteristic, interacts with the relationship between sustainability variables and firm performance. The empirical evidence from our analyses partly supports the second hypothesis that the relationship identified between market liquidity and the sustainability variables was negatively moderated by the size of the firm. In general this holds true for the linear relations identified, although our results are varied for the curvilinear relationships. The moderating effect from firm size was identified as stronger for larger firms when the sustainability scores were low. Conversely, for smaller firms this moderating effect on the market liquidity and sustainability relationship was stronger when their sustainability scores were high. These findings extend the liquidity and CSR disclosure research by Egginton and McBrayer (2019) through its inclusion of the firm size interaction term and are further congruent with extant literature. Drempetic et al. (2020) identified a significant influence of firm size on ESG and Lee (2008) demonstrated that when the sustainability score was high, smaller firms' market liquidity benefited more relative to that of larger firms. Other studies, however, found that larger firms' performance improved more than smaller firms when their sustainability scores increased (Hernández et al., 2019). The differences in research measures and methods might contribute to these inconsistencies in the empirical findings.

The extent of firms' investments into sustainable activities required for the investment to benefit the firm was shown in our study to be firm size dependent. Moreover, a secondary and somewhat surprising result was that the negative effect on market liquidity was more pronounced for larger firms than for smaller firms at low sustainability scores. Our findings are, to varying degrees, consistent with components of behavioural finance theory and stakeholder theory. The investors' inherent values and biases form their notions on which investments should be included or excluded from their investment strategies (Chava, 2014). We argue that the nature of investor responses to sustainability considerations differ between smaller and larger firms, and theorise that sustainability investments by firms below or considerably above investor expectations are unlikely to be as cost effective.

Lin et al. (2019) showed that larger firms' sustainability activities were a result of the attention received by stakeholders towards their actions and the cost of the investment. What motivates firms to continue their investments when these adversely affect their market liquidity may then be related to stakeholder considerations and their behavioural biases. As demonstrated by Sandberg (2011), stakeholders, in this case the investors, were willing to limit their economic prospects to firms which had good ESG practices. As firms increase their sustainability efforts, the expectations from stakeholders toward the firm's future ESG standards rise. Once larger

firms begin their investment activities into the sustainability variables they risk violating these expectations.

The present study further demonstrates, the point at which market liquidity started to improve was obtained earlier for smaller firms than larger firms. Pástor and Stambaugh (2003) showed that smaller firms were considered as less liquid than larger firms. This is further supported by Næs et al. (2011) maintaining that smaller firms were more sensitive to economic fluctuations, which impacted their market liquidity. Understanding that smaller firms have lower excess capital available for ESG related projects, we propose that investors are less likely to assume high sustainability related activities. The restricted capital availability of smaller firms would make them less likely to take on costly projects for the purpose of improving their sustainability scores. In support of this assertion, Lee (2008) and Mainardes et al. (2012) maintained that the pressure from stakeholders towards firms' sustainability efforts was greater for larger firms. This may partly explain why smaller firms' market liquidity benefits more and earlier from investments at lower levels of the sustainability scores, considering that stakeholders often have higher expectations toward larger and familiar firms. A double standard is thereby perceived amongst stakeholders towards firms sustainability performance depending e.g., on the nature and type of firm.

In addition, the results of our analyses show that the overall liquidity benefits were greater for smaller firms than larger firms. We propose that institutional investors in general invest in larger firms that fulfil their investment criteria. When these institutional owners perceive the level of sustainable activity to exceed an optimal level they would reduce their ownership stake (i.e., divest) in the firm as demonstrated by Harjoto et al. (2017). This is consistent with Chava (2014) who reported that lower ownership was congruent with higher sustainability scores. It is therefore expected that the divestment is greater for larger firms as they have higher levels of institutional ownership compared to smaller firms. Consequently, this results in a more modest liquidity improvement for larger firms. Alternatively, Lee (2008) suggested that smaller firms benefited more, in terms of their market liquidity, from their sustainability efforts due to lower external pressure from stakeholders.

The marginal effects at mean confirm our third hypothesis. The varying results between Brazil and Germany showed that firms on the German exchange require a larger investment into their sustainability activities before it benefits their market liquidity. This is consistent with Friede et al. (2015) who demonstrated that emerging markets had, compared to developed markets, a higher degree of positive relations between financial performance and sustainability.

Our findings confirm that of Ma et al. (2016) reporting the presence of a more pronounced market liquidity effect in emerging markets resulting from the relative scarcity in firm liquidity within this market. Moreover, the results of this thesis are in line with Cunha and Samanez (2013) showing that the overall sustainability investments by firms increase market liquidity, with the exception of Govern investments for larger firms in Brazil and Social investments for average and larger firms in Germany. This could be due to the cultural variations which exist between markets (Miras-Rodríguez et al., 2015). The cultural divergence may influence the biases and expectations the investors in these markets have. The perspectives of behavioural finance and stakeholder theory along with their interrelation with firms sustainability practices, are therefore, further proposed to be congruent with the variations seen in the effect on market liquidity between Brazil and Germany.

Contrary to our initial expectations, the analysis found evidence that the market liquidity of larger firms in Brazil's market worsened along with increases in their Govern scores. A possible explanation for these results may be attributed to the trust and transparency stakeholders have to the political environment and governance structures of larger firms in Brazil. Furthermore, stakeholders may be more familiar with larger firms and thereby be more reactive to their governance practices. As Chen et al. (2007) demonstrated, liquidity providers increase the lending costs and grant lower levels of liquidity for firms with poor governance practices, decreasing their market liquidity. However, for firms demonstrating good governance practices market liquidity improved (Chen et al., 2007). Conducting firm operations in a fashion which reinforces the investors trust and firms' credibility may thus contribute to legitimise the firms' ESG practices. This perspective is supported by Hosmer and Kiewitz (2005) maintaining that the moral conduct of the firm was related to the trust and commitment received by investors.

Alternatively, a similar result was found for Germany's Social score. As average and larger firms improved their Social scores, it adversely affected their market liquidity, more so for larger firms. A potential explanation for this effect on large and average sized firms may be related to the costs associated with implementing and maintaining social activities. With larger market shares and production capabilities the firms would require a larger workforce, which in turn increases the costs related to working conditions, career development and training, along with employees health and safety. This coincides with the results reported by Ng and Rezaee (2015) showing a marginal positive relationship between social performance and cost of equity (i.e., an increasing cost of equity) for the firms in their sample, while the cost of equity reduced for the environmental and governance scores. Moreover, Friede et al.'s (2015) meta-analysis

further identified the adverse effect of social scores on firm performance. It may therefore be argued that higher costs related to increasing the Social score worsens the firm's financial performance, which in turn may hurt a firm's market liquidity. Furthermore, efforts relating to product responsibility, including improving product quality, data privacy, and responsible marketing activities, would presumably increase as the firm becomes larger, claiming more of the firm's resources as a result of the pressure from their stakeholders.

Taking cultural variations into consideration, we propose that investors may have a higher set of expectations towards the social efforts from firms in developed markets such as Germany, stemming from a presumption of greater wealth and stricter operating standards for firms in developed markets. The results from our empirical analyses may enrich the behavioural and sustainability literature by highlighting the influence of firm size and regional dimensions in an ESG related decision-making process. With the exception of the Govern and Social score for Brazil and Germany, respectively, the present study demonstrates that firms exhibiting favourable sustainability scores incur increased market liquidity, which we propose is related to improvements in reputation and capital availability resulting from investors behavioural biases. We contend that stakeholder considerations play an important role in the motives behind firms' distinct sustainability activities in both Brazil and Germany. Our findings complement the growing body of ESG on market liquidity research such as that of Egginton and McBrayer (2019) through the inclusion of both emerging and developed markets. It further extends the work of Torre et al. (2020) through the focus on both ESG and the ESG pillars effect on market liquidity, and the inclusion Brazil (i.e., an emerging market).

This thesis demonstrates the applicability towards stakeholder and behavioural finance theories when explaining ESG practices by firms. Implications from this thesis are considered important for both academia and business. The growing complexity of the global business environment (Jones et al., 2018) provides an opportunity for the practical application of our results for stakeholder engagement, when considering the growing importance of stakeholder management. Firstly, the results imply that managers need to consider the effect the individual ESG pillars are likely to have on their firm's market liquidity. Moreover, the size of the firm should be reflected when considering the level of investment the firm affords each of these variables. Secondly, the awareness required by managers as to when a market liquidity benefit is obtained from each of the variables is implied. Managers should, therefore, arguably consider the investment structure and the degree of investment before commencing their sustainability efforts in order to maintain them at optimal levels. The integration of stakeholder interest in firm oper-

ations implies that firms' investment activities have a long-term perspective, which over time positively contributes to firm value and maximising stakeholder value.

A third implication might be that strategies for stakeholder engagement should be considered by firms when making sustainable investment decisions. Investors are important stakeholders in financial markets and regularly participate, providing feedback to firms through their digital platforms (Nason et al., 2028). Lastly, the increase in liquidity may indicate an increase in investors' awareness towards a firm. This in turn may benefit firms in their efforts to raise capital. A focus towards the sustainability variables should, therefore, be given when attempting to improve firms' market liquidity and will provide the firms with an advantage when raising capital. This implication is consistent with Chen et al. (2007) reporting that poor sustainability practices resulted in reduced equity liquidity and a higher cost for borrowing capital from liquidity providers. As key stakeholders, investors are thus viewed as an important factor which requires consideration when managing the firm's stakeholders in relation to their sustainability practices. It is, however, noted that our empirical work is based on historical data, and as such is retrospective. The results should therefore be interpreted with caution when drawing inferences from this study.

7 Conclusion

This thesis uses an empirical approach to examine the relationship between overall ESG along with the three ESG pillars and market liquidity, providing useful insights into the nature of this relationship. The empirical evidence confirmed the presence of a significant sustainability and market liquidity relationship for Brazil and Germany, the relationship being more pronounced for Brazil. The effect of the sustainability variables on market liquidity was both positive and negative depending upon how high the variables scores were and the shape of their relationship on market liquidity. This relationship was found to be curvilinear for Brazil's ESG and Social score, and Germany's ESG, Environ, and Govern score, whilst linear for Brazil's Environ and Govern score, and Germany's Social score. The growing awareness from stakeholders towards firms sustainability practices, makes our findings particularly interesting from an investment perspective. The results obtained may therefore make contributions to extant literature regarding firms sustainable investment practices. Moreover, the modelling and graphical representations presented in this thesis shed light on the proposed market liquidity and sustainability relationship, along with the regional variations between Brazil and Germany.

This thesis further contributes to literature by applying the concept of firm size to ESG and its three pillars. In line with other studies, the empirical evidence showed an interaction effect of firm size. Our graphical representations of the marginal effects provides a clarification of the firm size implications on the market liquidity and sustainability relationship. The moderating role of firm size on market liquidity was different depending upon region and the sustainability variable being analysed. In general, the results indicated that the influence of the sustainability variables on market liquidity was stronger for smaller firms compared to average and larger firms, when sustainability performance was higher. However, when firms sustainability performance was lower the interaction effect of firm size became stronger among larger firms compared with smaller and average sized firms, Brazil's Environ and Govern score, and Germany's Social score notwithstanding.

Our results contribute to extant sustainable investing literature and from a sustainability perspective, offer additional empirical support to the theory of behavioural finance and stakeholder engagement. These theories demonstrate the relevancy of emotions and biases in investors' decision-making, and the importance of firm strategies for stakeholder management. Although stakeholder engagement has been adopted for use in CSR research, it has not, to the authors knowledge, been applied to liquidity research. Stakeholder engagement is considered as relevant for ESG implementation by potentially offering solutions on how to accommodate stake-

holder interest into firms' ESG related operations. This thesis therefore extends the sustainability research within finance beyond the perspectives provided in previous research. Finally, the results of this thesis may enrich the liquidity literature by suggesting that stakeholder engagement strategies contribute to the success of a firm's ESG investing practices.

Limitations and Future research

This thesis is subject to limitations which may present avenues for future research. Only one rating agency is used for obtaining sustainability data. As such the data is restricted to the collection process performed by Refinitiv Eikon. A comparability study might therefore be relevant, utilising data from other rating agencies. Furthermore, the research approach only captures a portion (i.e., snapshot) of the overall sustainability data from 2010-2019. To examine whether the relationship between market liquidity and sustainability can persist over time, further research may be done applying a longitudinal research design. An additional study could also focus on the implications from the sustainability hype on market liquidity during the COVID-19 pandemic. Moreover, our research approach includes a broad base of industries. However, the variations between sustainability focus amongst industries and an overview of what kind of industries contribute the most to our results is lacking. Future research might therefore, extend our thesis by providing insight into the market liquidity and sustainability relationship on an industry basis.

Another issue worth highlighting is the moderate sustainability data available for Brazil. A more detailed and comprehensive analysis for Brazil may be made over a broader horizon once their ESG reporting practices improve. Moreover, given the unique features of emerging markets, caution is advised should our findings be generalised to other contexts. In addition, our sustainability measure is limited to the overall ESG score and it's three pillars, not taking the pillars' individual sub-categories into consideration. A comprehensive study which examines the implication of these individual sub-categories on the ESG and market liquidity relationship would be an interesting aspect for further study. Moreover, additional studies into the drivers of sustainable investing such as stakeholder trust toward corporations, cultural differences, and political climates, which are not measured in this thesis, are encouraged. Finding support for our hypotheses in both an emerging and developed market substantiates the importance of conducting additional empirical research on the relationship between market liquidity and sustainability. We encourage new research to improve upon the contributions of this thesis, by testing these findings with other methodological approaches and in other contexts.

References

Alquraan, T., Alqisie, A., & Shorafa, A., Amjad. (2016). ESG Impact on Market Performance of Firms: International Evidence. *American International Journal of Contemporary Research*, *6*(3), 159–169.

Amihud, Y., & Mendelson, H. (1986). Liquidity and Stock Returns. *Financial Analysts Journal*, *42*(3), 43–48.

Baker, K., H., & Nofsinger, R., John (Eds.). (2011). *Behavioral finance: investors, corporations and markets*. Wiley.

Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *The quarterly journal of economics*, *116*(1), 261–292.

Barnett, M., & Salomon, M. (2006). Beyond dichotomy: The curvilinear relationship between social responsibility and financial performance. *Strategic Management Journal*, *27*(11), 1101–1122.

Berman, S., Jones, T. M., Kotha, S., & Wicks, A. C. (1999). Does Stakeholder Orientation Matter: The Relationship between Stakeholder Management Models and Firm Financial Performance. *Academy of Management Review*, *42*(5), 488–506.

Broadstock, D. C., Chan, K., Cheng, L. T., & Wang, X. (2021). The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. *Finance Research Letters*, *38*, 1–10. https://doi.org/10.1016/j.frl.2020.101716

Chava, S. (2014). Environmental Externalities and Cost of Capital. *Management Science*, *60*(9), 2223–2247.

Chen, W.-P., Chung, H., Lee, C., & Liao, W.-L. (2007). Corporate Governance and Equity Liquidity: analysis of S&P transparency and disclosure rankings. *Corporate Governance*, *15*(4), 644–660.

Clarkson, M. (1995). A stakeholder framework for analyzing and evaluating corporate social performance. *Academy of Management Review*, *20*(1), 92–117.

Consolandi, C., Eccles, R. G., & Gabbi, G. (2020). How material is a material issue? Stock returns and the financial relevance and financial intensity of ESG materiality. *Journal of Sustainable Finance and Investment*. https://doi.org/10.1080/20430795.2020.1824889

Cormier, D., Ledoux, M. J., & Magnan, M. (2011). The informational contribution of social and environmental disclosures for investors. *Management Decision*, *49*(8), 1276–1304. https://doi.org/10.1108/00251741111163124

Corwin, S. A., & Schultz, P. (2012). A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices. *Journal of Finance*, *67*(2), 719–759. https://doi.org/10.1111/j.1540-6261.2012.01729.x.

Costantini, M., & Lupi, C. (2012). A Simple Panel–CADF Test for Unit Roots. *Oxford Bulletin of Economics and Statistics*, *75*(2), 276–296. https://doi.org/10.1111/j.1468-0084.2012.00690.x

Crane, A., & Ruebottom, T. (2011). Stakeholder Theory and Social Identity: Rethinking Stakeholder Identification. *Journal of Business Ethics*, *102*, 77–87. https://doi.org/10.1007/s10551-011-1191-4

Cunha, F. A. F. d. S., & Samanez, C. P. (2013). Performance Analysis of Sustainable Investments in the Brazilian Stock Market: A Study About the Corporate Sustainability Index (ISE). *Journal of Business Ethics*, *117*(1), 19–36. https://doi.org/10.1007/s10551-012-1484-2

Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of Management Review*, *20*(1), 65–91.

Dowell, G., Hart, S., & Yeung, B. (2000). Do corporate global environmental standards create or destroy market value? *Management science*, *46*(8), 1059–1074.

Drempetic, S., Klein, C., & Zwergel, B. (2020). The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review. *Journal of Business Ethics*, *167*(2), 333–360. https://doi.org/10.1007/s10551-019-04164-1

ECB. (2021). *German debt securities*. https://sdw.ecb.europa.eu/browse.do?node=bbn3885

Egginton, J. F., & McBrayer, G. A. (2019). Does it pay to be forthcoming? Evidence from CSR disclosure and equity market liquidity. *Corporate Social Responsibility and Environmental Management*, *26*(2), 396–407. https://doi.org/10.1002/csr.1691

EPA. (2015). *Notice of Violation on Clean Air Act to VW (18.September.2015)*. United States Environmental Protection Agency.

Fassin, Y. (2012). Stakeholder Management, Reciprocity and Stakeholder Responsibility. *Journal of Business Ethics*, *109*(1), 83–96.

FED. (2021). *Brazilian treasury bills (intgstbrm193n)*. https://fred.stlouisfed.org/series/INTGSTBRM193N

Fiskerstrand, S. R., Fjeldavli, S., Leirvik, T., Antoniuk, Y., & Nenadić, O. (2020). Sustainable investments in the Norwegian stock market. *Journal of Sustainable Finance and Investment*, *10*(3), 294–310. https://doi.org/10.1080/20430795.2019.1677441

Freeman, E., R. (Ed.). (1984). *Strategic Management: A Stakeholder Approach*. Pitman.

Friede, G., Busch, T., & Bassen, A. (2015). Esg and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance Investment*, *5*(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

Frooman, J. (1999). Stakeholder influence strategies. *Academy of Management Review*, *24*(2), 191–295.

Harjoto, M., Jo, H., & Kim, Y. (2017). Is Institutional Ownership Related to Corporate Social Responsibility? The Nonlinear Relation and Its Implication for Stock Return Volatility. *The Journal of Finance*, *146*(1), 77–109.

Hernández, J. P. S.-I., Yañez-Araque, B., & Moreno-García, J. (2019). Moderating effect of firm size on the influence of corporate social responsibility in the economic performance of micro-, small-and medium-sized enterprises. *Technological Forecasting and Social Change*, *151*. https://doi.org/10.1016/j.techfore.2019.119774

Hosmer, T., L., & Kiewitz, C. (2005). Organizational justice: A behavioral science concept with critical implications for business ethics and stakeholder theory. *Business Ethics Quarterly*, *47*(1), 67–91.

Huselid, M. A. (1995). The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of management journal*, *38*(3), 635–672.

Im, K. S., Pesaran, M., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, *115*(1), 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7

Jones, T. M. (1995). Instrumental stakeholder theory: A synthesis of ethics and economics. *Academy of Management Review*, *20*(2), 404–437.

Jones, T. M., Harrison, S., Jeffery, & Felps, W. (2018). How applying instrumental stakeholder theory can provide sustainable competitive advantage. *Academy of Management Review*, *43*(3), 371–391. https://doi.org/10.5465/amr.2016.0111

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the econometric society*, *47*(2), 263–292.

Kumar, N. C., Ashwin, Smith, C., Badis, L., Wang, N., Ambrosy, P., & Tavares, R. (2016). ESG factors and risk-adjusted performance: a new quantitative model. *Journal of sustainable finance investment*, *6*(4), 292–300.

Lee, P., Min-Dong. (2008). A review of the theories of corporate social responsibility: Its evolutionary path and the road ahead. *International Journal of Management Reviews*, *10*(1), 53–73. https://doi.org/10.1111/j.1468-2370.2007.00226.x

Lesmond, D. A. (2005). Liquidity in emerging markets. *Journal of Financial Economics*, *77*(2), 411–452. https://doi.org/10.1016/j.jfineco.2004.01.005

Lin, W.-L., Cheah, J.-H., Azali, M., Ho, J. A., & Yip, N. (2019). Does firm size matter? evidence on the impact of the green innovation strategy on corporate financial performance in the automotive sector. *Journal of Cleaner Production*, *229*, 974–988. https://doi.org/10.1016/j.jclepro.2019.04.214

Ma, R., Anderson, H. D., & Marshall, B. R. (2016). International stock market liquidity: a review. *Managerial Finance*, *42*(2), 118–135. https://doi.org/10.1108/MF-04-2015-0096

Mainardes, W., Emerson, Alves, H., & Raposo, M. (2012). A model for stakeholder classification and stakeholder relationships. *Management Decision*, *50*(10), 1861–1879. https://doi.org/10.1108/00251741211279648

Manganelli, S., & Wolswijk, G. (2009). What Drives Spreads in the Euro Area Government Bond Market? *Economic Policy*, *24*(58), 191–240.

Mervelskemper, L., & Streit, D. (2017). Enhancing Market Valuation of ESG Performance: Is Integrated Reporting Keeping its Promise? *Business Strategy and the Environment*, *26*(4), 536–549. https://doi.org/10.1002/bse.1935

Miles, S. (2017). Stakeholder Theory Classification: A Theoretical and Empirical Evaluation of Definitions. *Journal of Business Ethics*, *142*, 437–459. https://doi.org/10.1007/s10551-015-2741-y

Miralles-Quirós, M. d. M., Miralles-Quirós, J. L., & Valente-Gonçalves, L. (2018). The Value Relevance of Environmental, Social, and Governance Performance: The Brazilian Case. *Sustainability (Switzerland)*, *10*(3), 574. https://doi.org/10.3390/su10030574

Miras-Rodríguez, M. d. M., Carrasco-Gallego, A., & Escobar-Pérez, B. (2015). Are socially responsible behaviors paid off equally? a cross-cultural analysis. *Corporate Social Responsibility and Environmental Management*, *22*(4), 237–256. https://doi.org/10.1002/csr.1344

MSCI. (2020). *Msci global market accessibility review*. MSCI.

Næs, R., Skjeltorp, J. A., & Ødegaard, B. A. (2011). Stock Market Liquidity and the Business Cycle. *Journal of Finance*, *66*(1), 139–176. https://doi.org/10.1111/j.1540-6261.2010.01628.x

Nason, S., R, Bacq, S., & Gras, D. (2028). A behavioral theory of social performance: social identity and stakeholder expectations. *Academy of management review*, *43*(2), 259–283. https://doi.org/10.5465/amr.2015.0081

Ng, A. C., & Rezaee, Z. (2015). Business sustainability performance and cost of equity capital. *Journal of Corporate Finance*, *34*, 128–149. https://doi.org/10.1016/j.jcorpfin.2015.08.003

Nuber, C., Velte, P., & Hörisch, J. (2019). The curvilinear and time-lagging impact of sustainability performance on financial performance: Evidence from Germany. *Corporate Social Responsibility and Environmental Management*, *27*(1), 232–243. https://doi.org/10.1002/csr.1795

O'Riordan, L., & Fairbrass, J. (2014). Managing CSR Stakeholder Engagement: A New Conceptual Framework. *Journal of Business Ethics*, *125*, 121–145. https://doi.org/10.1007/s10551-013-1913-x

Pástor, Ľ., & Stambaugh, R. F. (2003). Liquidity Risk and Expected Stock Returns. *Journal of Political Economy*, *111*(3), 642–685.

Phillips, R. (2008). Stakeholder legitimacy. *Business Ethics Quarterly*, *13*(1), 25–41.

Preble, J. F. (2005). Toward a Comprehensive Model of Stakeholder Management. *Business and Society Review*, *110*(4), 407–431. https://doi.org/10.1111/j.0045-3609.2005.00023.x

Refinitiv. (2021). *Environmental, social and governance (ESG) scores from refinitiv (LSEG business framework 02/2021)*. https://www.refinitiv.com/en/sustainable-finance/esg-scores

Rehman, U., Ramiz, Zhang, J., Uppal, J., Cullinan, C., & Akram, N., Muhammad. (2016). Are environmental social governance equity indices a better choice for investors? An Asian perspective. *Business ethics (Oxford, England)*, *25*(4), 440–459.

Sandberg, J. (2011). Socially Responsible Investment and Fiduciary Duty: Putting the Freshfields Report into Perspective. *Journal of Business Ethics*, *101*(1), 143–162. https://doi.org/10.1007/s10551-010-0714-8

Sassen, R., Hinze, A. K., & Hardeck, I. (2016). Impact of ESG factors on firm risk in Europe. *Journal of Business Economics*, *86*(8), 867–904. https://doi.org/10.1007/s11573-016-0819-3

Sultana, S., Zulkifli, N., & Zainal, D. (2018). Environmental, social and governance (ESG) and investment decision in Bangladesh. *Sustainability (Switzerland)*, *10*(6), 1–19. https://doi.org/10.3390/su10061831

Szyszka, A. (2013). *Finance and capital markets: How investor psychology influences asset pricing*. Palgrave Macmillan.

Torre, M. L., Mango, F., Cafaro, A., & Leo, S. (2020). Does the ESG index affect stock return? Evidence from the Eurostoxx50. *Sustainability (Switzerland)*, *12*(16), 1–12. https://doi.org/10.3390/SU12166387

Trumpp, C., & Günther, T. (2017). Too little or too much? exploring u-shaped relationships between corporate environmental performance and corporate financial performance. *Business Strategy and the Environment*, *26*, 49–68. https://doi.org/10.1002/bse.1900

Volkswagen. (2015). *Press release, 09/22/2015*. Retrieved March 31, 2021, from https://www.volkswagen - newsroom . com / en / press - releases / volkswagen - ag - has - issued - the - following-information-1690

Wagner, M., & Blom, J. (2011). The reciprocal and non-linear relationship of sustainability and financial performance. *Business Ethics: A European Review*, *20*(4), 418–432. https://doi.org/10.1111/j.1467-8608.2011.01622.x

Wang, H., Lu, W., Ye, M., Chau, K., & Zhang, X. (2016). The curvilinear relationship between corporate social performance and corporate financial performance: Evidence from the international construction industry. *Journal of Clear Production*, *137*, 1313–1322.

World Bank. (2021). *World development indicators | gdp*. https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.MKTP.CD&country=

Appendix

The following Appendix presents the two approaches used for the robustness check. A.1 provides the results of the random effects regression analysis for the overall ESG and the three ESG pillars where relative spread is assigned as the dependent variable. The results are presented in Table A.1. A.2 provides the regression results applying a pooled OLS estimation methodology to our data samples, presenting the results in Table A.2.

A.1 Robustness check: Relative spread as liquidity measure

Table A.1
Random Effect Regressions: Relative Bid-Ask Spread

The random effects regression results are provided in this table with relative bid-ask spread as the dependent variable. White robust standard errors with firm clustering are reported within parentheses. Joint significance tests include all terms involving the four explanatory variables in the respective models. The ***, ** and * denote significance, respectively, at the 1%, 5% and 10% levels. The panels of Brazil and Germany have 603 and 730 observations, respectively. Both model significance test and joint significance test reports Chi-squared (χ^2) statistics.

Panel A: ESG Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
ESG	0.00004	-0.084^{***}	-0.080^{***}	0.001	-0.143^{***}	-0.151^{***}
	(0.002)	(0.027)	(0.027)	(0.001)	(0.040)	(0.041)
Mkt Cap x ESG		0.004^{***}	0.004^{***}		0.006^{***}	0.007^{***}
		(0.001)	(0.001)		(0.002)	(0.002)
ESG ^{2}			-0.019^{***}			-0.010^{**}
			(0.007)			(0.005)
Return	0.0003	0.0004	0.0004	0.0003	0.0002	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volatility	0.370^{***}	0.362^{***}	0.353^{***}	0.069^{***}	0.069^{***}	0.069^{***}
	(0.052)	(0.049)	(0.049)	(0.001)	(0.002)	(0.002)
Yield	0.019	0.025^{*}	0.024^{*}	-0.021^{**}	-0.017^{**}	-0.017^{**}
	(0.014)	(0.014)	(0.014)	(0.010)	(0.009)	(0.009)
Mkt Cap	0.0002	-0.001^{*}	-0.001^{*}	-0.003^{***}	-0.007^{***}	-0.007^{***}
	(0.0003)	(0.001)	(0.001)	(0.0003)	(0.001)	(0.001)
Volume	-0.004^{***}	-0.004^{***}	-0.004^{***}	-0.0001	-0.0003^{**}	-0.0003^{**}
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Y14/15	-0.001	-0.001	-0.001	0.002^{**}	0.001^{**}	0.001^{**}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.046^{***}	0.077^{***}	0.079^{***}	0.079^{***}	0.158^{***}	0.164^{***}
	(0.007)	(0.016)	(0.016)	(0.007)	(0.030)	(0.031)
Adjusted R^2	0.583	0.612	0.610	0.686	0.751	0.752
Model Sig. Test	415.310^{***}	409.138^{***}	449.730^{***}	3087.165^{***}	3617.807^{***}	3790.691^{***}
Joint Sig. Test		9.605^{***}	14.093^{***}		13.089^{***}	13.855^{***}

(Continued)

Table A.1 – *Continued*

Panel B: Environmental Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Environ	−0.001	−0.025	−0.027	0.001	−0.086***	−0.106***
	(0.001)	(0.020)	(0.020)	(0.001)	(0.026)	(0.029)
Mkt Cap x Environ		0.001	0.001		0.004***	0.005***
		(0.001)	(0.001)		(0.001)	(0.001)
Environ ^{2}			−0.009*			−0.012***
			(0.005)			(0.004)
Return	0.0003	0.0003	0.0003	0.0003	0.0002	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volatility	0.370***	0.374***	0.372***	0.069***	0.067***	0.067***
	(0.052)	(0.052)	(0.051)	(0.002)	(0.002)	(0.002)
Yield	0.018	0.020	0.020	−0.021**	−0.019**	−0.016*
	(0.014)	(0.014)	(0.014)	(0.010)	(0.009)	(0.009)
Mkt Cap	0.0003	0.00002	−0.0001	−0.003***	−0.005***	−0.006***
	(0.0003)	(0.001)	(0.001)	(0.0004)	(0.001)	(0.001)
Volume	−0.004***	−0.004***	−0.004***	−0.0001	−0.0003**	−0.0004**
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0001)
Y14/15	−0.001	−0.001	−0.001	0.002**	0.001**	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.045***	0.051***	0.052***	0.080***	0.128***	0.141***
	(0.007)	(0.013)	(0.013)	(0.007)	(0.022)	(0.025)
Adjusted R^2	0.581	0.586	0.591	0.687	0.721	0.733
Model Sig. Test	420.345***	427.870***	466.156***	3178.892***	4024.638***	3996.9***
Joint Sig. Test		2.717	5.619		11.851***	19.283***
Panel C: Social Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Social	−0.001	−0.076***	−0.073***	0.002	−0.125***	−0.127***
	(0.001)	(0.024)	(0.024)	(0.001)	(0.038)	(0.039)
Mkt Cap x Social		0.003***	0.004***		0.006***	0.006***
		(0.001)	(0.001)		(0.002)	(0.002)
Social ^{2}			−0.019***			−0.005
			(0.005)			(0.004)
Return	0.0003	0.0004	0.0004	0.0003	0.0002	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volatility	0.369***	0.364***	0.353***	0.069***	0.071***	0.071***
	(0.053)	(0.050)	(0.050)	(0.001)	(0.002)	(0.002)
Yield	0.018	0.023*	0.025*	−0.020**	−0.017*	−0.016*
	(0.014)	(0.014)	(0.014)	(0.010)	(0.009)	(0.009)
Mkt Cap	0.0002	−0.001*	−0.001*	−0.003***	−0.007***	−0.007***
	(0.0003)	(0.001)	(0.001)	(0.0003)	(0.001)	(0.001)
Volume	−0.004***	−0.004***	−0.004***	−0.0001	−0.0003**	−0.0003**
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Y14/15	−0.001	−0.001	−0.001	0.001**	0.001**	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.046***	0.077***	0.078***	0.079***	0.156***	0.159***
	(0.007)	(0.015)	(0.015)	(0.006)	(0.030)	(0.030)
Adjusted R^2	0.581	0.607	0.607	0.687	0.752	0.751
Model Sig. Test	427.269***	418.719***	455.722***	3221.855***	2207.976***	2158.050***
Joint Sig. Test		10.927***	15.709***		13.998***	13.725***

(Continued)

Table A.1 − *Continued*

Panel D: Governance Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Govern	0.001	−0.062**	−0.065**	−0.001	−0.121***	−0.125***
	(0.001)	(0.028)	(0.029)	(0.001)	(0.033)	(0.036)
Mkt Cap x Govern		0.003**	0.003**		0.005***	0.006***
		(0.001)	(0.001)		(0.001)	(0.002)
Govern ^{2}			0.005			−0.005
			(0.006)			(0.004)
Return	0.0003	0.0003	0.0003	0.0003	0.0001	0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volatility	0.370***	0.349***	0.347***	0.069***	0.067***	0.067***
	(0.052)	(0.049)	(0.049)	(0.001)	(0.002)	(0.002)
Yield	0.019	0.024*	0.024*	−0.024**	−0.019**	−0.019**
	(0.014)	(0.014)	(0.014)	(0.010)	(0.009)	(0.009)
Mkt Cap	0.0002	−0.001	−0.001	−0.003***	−0.006***	−0.006***
	(0.0003)	(0.001)	(0.001)	(0.0003)	(0.001)	(0.001)
Volume	−0.004***	−0.004***	−0.004***	−0.00003	−0.0002	−0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Y14/15	−0.001	−0.001	−0.001	0.002**	0.001**	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.046***	0.075***	0.075***	0.077***	0.135***	0.138***
	(0.007)	(0.015)	(0.015)	(0.006)	(0.023)	(0.025)
Adjusted R^2	0.584	0.608	0.610	0.685	0.743	0.746
Model Sig. Test	393.914***	400.719***	416.815***	3079.992***	2796.616***	3123.593***
Joint Sig. Test		4.988*	5.310		13.250***	13.397***

A.2 Robustness check: Pooled OLS as estimation method

Table A.2
Pooled OLS Regressions: Zero Return Measure

The table shows the results from pooled OLS regression analysis with Zero Return Measure as the dependent variable. White robust standard errors with firm clustering are reported within parentheses. Joint significance tests include all terms involving the four explanatory variables in the respective models. The ***, ** and * denote significance, respectively, at the 1%, 5% and 10% levels. The panels of Brazil and Germany have 603 and 730 observations, respectively. Both model significance test and joint significance test reports Chi-squared (χ^2) statistics.

Panel A: ESG Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
ESG	−0.022*	−0.438*	−0.441*	0.001	−0.125***	−0.153***
	(0.013)	(0.251)	(0.250)	(0.002)	(0.042)	(0.043)
Mkt Cap x ESG		0.018	0.020*		0.006***	0.008***
		(0.011)	(0.012)		(0.002)	(0.002)
ESG ^{2}			−0.044			−0.028***
			(0.061)			(0.010)
Return	0.002	0.0004	0.0004	−0.001	−0.001	−0.001
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	1.635***	1.559***	1.525***	0.055***	0.054***	0.054***
	(0.344)	(0.313)	(0.318)	(0.002)	(0.002)	(0.002)
Yield	0.033	0.053	0.052	−0.432***	−0.432***	−0.430***
	(0.097)	(0.094)	(0.094)	(0.019)	(0.019)	(0.019)
Mkt Cap	0.008***	0.00004	−0.001	−0.0005	−0.004***	−0.005***
	(0.003)	(0.005)	(0.005)	(0.0004)	(0.001)	(0.001)
Volume	−0.012***	−0.012***	−0.012***	−0.002***	−0.002***	−0.002***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.007	−0.007	−0.006	0.015***	0.015***	0.015***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	0.035	0.228*	0.237**	0.100***	0.180***	0.200***
	(0.053)	(0.119)	(0.120)	(0.009)	(0.030)	(0.031)
Adjusted R^2	0.293	0.305	0.305	0.548	0.557	0.560
Model Sig. Test	13.672***	11.750***	12.307***	264.766***	219.146***	191.492***
Joint Sig. Test		11.425***	11.525***		9.990***	16.787***

(Continued)

Table A.2 – *Continued*

Panel B: Environmental Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Environ	−0.037***	0.153	0.153	0.001	−0.106***	−0.141***
	(0.009)	(0.144)	(0.146)	(0.002)	(0.034)	(0.035)
Mkt Cap x Environ		−0.008	−0.008		0.005***	0.007***
		(0.006)	(0.007)		(0.002)	(0.002)
Environ ^{2}			0.003			−0.024***
			(0.035)			(0.006)
Return	0.002	0.002	0.002	−0.001	−0.001	−0.001
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	1.578***	1.580***	1.580***	0.055***	0.052***	0.050***
	(0.337)	(0.340)	(0.340)	(0.002)	(0.003)	(0.003)
Yield	0.044	0.036	0.036	−0.432***	−0.431***	−0.427***
	(0.095)	(0.094)	(0.095)	(0.019)	(0.019)	(0.019)
Mkt Cap	0.009***	0.012***	0.012***	−0.0005	−0.004***	−0.005***
	(0.003)	(0.004)	(0.004)	(0.0004)	(0.001)	(0.001)
Volume	−0.012***	−0.011***	−0.011***	−0.002***	−0.002***	−0.002***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.007	−0.007	−0.007	0.015***	0.015***	0.015***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	0.015	−0.054	−0.054	0.100***	0.169***	0.195***
	(0.055)	(0.089)	(0.090)	(0.009)	(0.026)	(0.027)
Adjusted R^2	0.316	0.319	0.318	0.548	0.557	0.565
Model Sig. Test	14.086***	14.510***	13.587***	266.926***	194.890***	159.684***
Joint Sig. Test		18.148***	18.297***		10.391***	22.706***
Panel C: Social Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Social	−0.020*	−0.334	−0.341	0.004	−0.126***	−0.138***
	(0.011)	(0.219)	(0.221)	(0.002)	(0.037)	(0.038)
Mkt Cap x Social		0.013	0.015		0.006***	0.007***
		(0.010)	(0.011)		(0.002)	(0.002)
Social ^{2}			−0.036			−0.013
			(0.046)			(0.008)
Return	0.002	0.001	0.001	−0.001	−0.001	−0.001
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	1.613***	1.551***	1.518***	0.055***	0.056***	0.057***
	(0.346)	(0.319)	(0.319)	(0.002)	(0.002)	(0.002)
Yield	0.031	0.041	0.045	−0.430***	−0.430***	−0.428***
	(0.096)	(0.095)	(0.095)	(0.019)	(0.019)	(0.019)
Mkt Cap	0.008***	0.002	0.001	−0.001*	−0.005***	−0.005***
	(0.003)	(0.005)	(0.005)	(0.0004)	(0.001)	(0.001)
Volume	−0.012***	−0.012***	−0.012***	−0.002***	−0.002***	−0.002***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.007	−0.006	−0.006	0.015***	0.015***	0.015***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	0.035	0.193*	0.200*	0.104***	0.193***	0.205***
	(0.053)	(0.113)	(0.116)	(0.008)	(0.028)	(0.029)
Adjusted R^2	0.293	0.301	0.301	0.550	0.562	0.563
Model Sig. Test	13.818***	11.826***	11.772***	249.059***	247.369***	219.360***
Joint Sig. Test		11.256***	11.199**		18.186***	21.768***

(Continued)

Table A.2 − *Continued*

Panel D: Governance Score						
	Brazil			Germany		
	(1)	(2)	(3)	(1)	(2)	(3)
Govern	0.007	−0.607**	−0.617**	−0.002	−0.062*	−0.092**
	(0.011)	(0.246)	(0.256)	(0.002)	(0.035)	(0.038)
Mkt Cap x Govern		0.027**	0.026**		0.003*	0.005***
		(0.011)	(0.010)		(0.002)	(0.002)
Govern ^{2}			0.023			−0.025***
			(0.051)			(0.008)
Return	0.002	−0.0003	−0.0003	−0.001	−0.001	−0.001
	(0.005)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)
Volatility	1.670***	1.512***	1.516***	0.056***	0.053***	0.052***
	(0.337)	(0.291)	(0.293)	(0.002)	(0.003)	(0.003)
Yield	0.022	0.060	0.060	−0.435***	−0.435***	−0.437***
	(0.096)	(0.093)	(0.093)	(0.019)	(0.019)	(0.019)
Mkt Cap	0.007***	−0.006	−0.006	−0.0002	−0.002	−0.003**
	(0.003)	(0.005)	(0.005)	(0.0004)	(0.001)	(0.001)
Volume	−0.012***	−0.012***	−0.012***	−0.002***	−0.002***	−0.002***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0003)	(0.0003)
Y14/15	−0.006	−0.006	−0.006	0.015***	0.015***	0.015***
	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Constant	0.052	0.359***	0.358***	0.096***	0.130***	0.151***
	(0.052)	(0.116)	(0.115)	(0.008)	(0.024)	(0.027)
Adjusted R^2	0.288	0.316	0.316	0.549	0.551	0.555
Model Sig. Test	12.165***	10.722***	10.960***	244.792***	174.750***	181.062***
Joint Sig. Test		6.453**	6.653*		4.128	11.564***