The impact of Environmental, Social and Governance (ESG) attributes on the performance of listed real estate within Europe.

Lo, Daniel[1], McCord, M[1]., Haran, M[1]., Davis, P[1]., McCord, J[2]., Pogue, M[3].
[1]School of Architecture and the Built Environment, Ulster University, Belfast, UK.
[2] School of Law, Ulster University, Belfast, UK.
[3]Department of Accountancy, Finance and Economics, Ulster University, Belfast, UK

Corresponding author d.lo@ulster.ac.uk

Abstract/Executive summary

The intensification of the climate change debate has seen a shift globally within investment mandates and undoubtedly sharpened focus towards Environmental, Social and Corporate Governance (ESG) actions. Consequently, the real estate sector has witnessed increased focus on the evolution of ESG within investment mandates to reduce information asymmetry, financial irregularity risks whilst enhancing risk profiling and firm value. Despite this heightened attention, there has been mixed findings investigating the role of ESG and performance. Indeed, despite the fact that ESG is increasingly dominating boardroom agendas, criticisms remain namely; that not all of components have received adequate or equal attention, while many companies have struggled to put ESG pledges into practice. Consequently, the relationship between ESG and financial performance of listed real estate has been a topic of much debate amongst academics, practitioners and policy-makers.

This study, applying Bloomberg data and annual financial reports of the sample companies for five European listed real estate markets selected on the basis of their maturity of ESG development over the period 2010-2022, explores whether, and to what extent, the performance of the real estate companies, can be attributed to or explained by the implementation of ESG policies at the corporate level after accounting for firm-level characteristics as well as different real estate sectors. We employ Pedroni's Cointegration and Granger (Wald exogeneity) Causality methods for determination of long-run cointegration and short-run causal relationships permitting insights into the ESG factors that influence the stock price performance of the listed real estate markets over time. Secondly, a number of panel regression models are constructed to investigate whether and to what degree the ESG attributes can explain the firm-level performance. Our key findings highlight there to be no statistical evidence that ESG attributes depress the performance of the listed real estate companies proxied by raw return, Sharpe and Tobin's q, or produce statistically insignificant results. The Causality analysis determines that some ESG attributes actually Granger-cause raw return, adjusted return and Tobin's q. Our analysis, as evidenced within the Pedroni Cointegration tests further reveal strong long-term interlinkages between the high majority of the ESG attributes and the three performance indicators. Based on the results of the Granger Causality models, we further find that the three aggregate Bloomberg ESG performance scores all Granger-cause raw returns and the Sharpe ratio in the long-run suggesting that higher environmental, social and governance performance scores of companies should lead to a superior return on both the raw and risk-adjusted basis.

Introduction

Since the signing of the treaty during the United Nations COP21 meeting in Paris in 2015, institutional investors are under increasing pressure from governments, regulators and other stakeholders to contribute to carbon abatement and climate mitigation (Brounen et al., 2021). The real estate sector contributes up to an estimated 36% of GHG emissions and consumes approximately one third of total energy worldwide (World Green Building Council, 2021; Brooks &McArthur, 2020; Vrensen et al., 2020), with consumption expected to increase by over one quarter by 2050 on current projections (Ooi & Dung, 2019). Thus, the carbon profile of institutional real estate investment portfolios is of particular significance in order to meet the 2050 climate abatement projections and the adoption and awareness of mitigating GHG emissions. The intensification of the climate change debate has seen a shift globally within investment mandates and undoubtedly sharpened focus towards the Environmental, Social and Corporate Governance (ESG) lens (Courtlier, 2020), which are seen to generate risk that is equally significant in the investment assessment as financial data (Alareeni and Hamdan, 2020).

The search for a relationship between ESG criteria and corporate financial performance (CFP) can be traced back to the beginning of the 1970s where Corporate Social Responsibility (CSR) emerged as a decision making and risk evaluation tool for investors (Friede, Busch and Bassen, 2015). Since then, capital allocation choices and the assessment of expected rate of return and the level of investment risk has been based on the disclosure of publicly available information provided by both companies and capital market participants, not only in the financial dimension, but also through a permanent combination of management in the economic, social and environmental dimensions (Czerwińska and Kaźmierkiewicz,2015). Consequently, the real estate sector has seen a rise in the importance of ESG measures around the world (Cloutier, 2020) due to the increasing focus and evolution of ESG within investment mandates seeking out enhanced returns performance (Ooi and Dung, 2019), the heightening ability to track and measure ESG, the nuances in investment options ESG offers, and for firm level reputation and achieving the climate change agenda (Friede, Busch & Bassen, 2015; Vrensen et al., 2020; Cloutier et al., 2021). As contended by Cloutier (2020), ESG is no longer an emerging trend, but a critical component of real estate investment integrated into investment decision-making and has become the 'new norm' as a material risk and opportunity within real estate as it offers reduced information asymmetry and financial irregularity risks, whilst enhancing risk profiling and firm value (Czerwińska and Kaźmierkiewicz, 2015; Feng and Wu, 2021; Yuan et al. 2021).

This path has been evidenced by the clear transition towards responsible investment practices and greater transparency and stakeholder engagement towards ESG initiatives. Recent market forces and industry initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD) are encouraging property owners to assess and publicly disclose climate risks to investors and other stakeholders. Most notably, there is increased collection and voluntary reporting on ESG data which continues to grow in popularity and scope. Indeed, as of March 2020, 3,826 institutions worldwide have joined the UN Principles of Responsible Investment and consider ESG issues during decision-making processes, compared to 734 in 2010, with assets under management valued at $121.3 trillion compared to $21.0 trillion (Yuan, Li, Xu, and Shang, 2022). Equally, organisations such as GRESB, represents over $4 trillion in real asset value (Cloutier, 2020), with the European Public Real Estate Association (EPRA) also launching a comprehensive database in 2019 covering publicly available ESG data from European REITs in an effort to promote ESG disclosure by the firms.

In a regulatory sense, in 2021, both the European Union (EU) through the EU Sustainable Finance Taxonomy, and the United States Securities and Exchange Commission (SEC) announced that they required increased monitoring and regulatory disclosure of ESG related activities and greenhouse gas (GHG) related risks[1]. This has seen the mandatory implementation of a new set of screening criteria developed designed to help companies, investors, and other stakeholders evaluate the environmental impact of financial products. This enhanced regulation has seen bodies and institutions such as the Counsellors of Real Estate (CRE) alter the ranking of ESG from tenth to the third most influential issue affecting real estate (Robinson and McIntosh, 2022).

Whilst there has been clear progress within financial markets towards accounting for ESG, there has not been a paradigm shift evident within some dimensions of mainstream investment toward embracing more sustainable investment practices, principally due to ESG criteria remaining fragmented (Friede, Busch and Bassen, 2015). This was also noted by Feng and Wu (2021) who illustrated that despite investors increasingly looking to adopt ESG factors into their business decisions, evidence suggests that ESG criteria remain hard to define with disagreement across ESG data providers on ESG ratings (Christensen et al., 2022). Further, Yuan et al. (2022) also caution that the drastic growth in ESG also comes with potential downsides with studies showing conflicting results (Hoepner and McMillan 2009; Revelli and Viviani 2015).

In terms of real estate, empirical studies on ESG remain in embryonic. The work of Brounen et al. (2021), noted that partial evaluations have been undertaken on the interlinkages between the variety of ESG metrics and financial performance in the public real estate market. This trend is also observed in the recent study of Newell and Marzuki (2022) who found considerable variation within ESG and environmental sustainability practices, procedures and frameworks across the 99 real estate markets investigated. They found in comparison to the other five dimensions for real estate market transparency, environmental sustainability was well behind the curve, and despite noting that whilst some progress has been made in recent years, it has been slow suggesting that, at the global level, more is needed to increase the focus on ESG and specifically on climate risk mitigation, climate resilience and zero-carbon in real estate investment.

Robinson and McIntosh (2022) in their extensive literature review into ESG in commercial real estate, show that this has tended to focus upon on a single component, generally the environmental criteria, with more limited insights examining the social and governance ESG criteria. They identified that gaps remain particularly in social and governance measures, and the impact of governance within private markets and defining their business and community impact. This was also noted by Alareeni and Hamdan (2020) who indicated that the majority of studies (Barnett and Salomon, 2012a, 2012b; Han et al., 2016a, 2016b) have concentrated on

[1]See:https://www.eba.europa.eu/eba-advises-commission-kpis-transparency-institutions%E2%80%99-environmentally-sustainable-activities ; https://www.sec.gov/rules/proposed/2022/33-11061.pdf

a single dimension of ESG such as environmental or social disclosure and that it is essential to focus on all dimensions of ESG when investigating performance. Further, despite the voluminous growth in the availability of ESG data, and an increase in studies focussing on real estate, these have been dominated by empirical evidence pertaining to REITs and ESG, the majority of which have examined the US REIT market (Brounen & Marcato, 2018; Cajias et al., 2014; Coen et al., 2018; Devine et al., 2016; Eichholtz et al., 2012; Fuerst, 2015; Sah et al., 2013).

It is in this context that this research is positioned and where our contribution to knowledge is based within the extant literature. We undertake an analysis of various firm-level ESG-related attributes that affect the financial performance of listed real estate companies across five major European stock markets, selected primarily on the basis of their maturity of ESG development. More specifically, the study explores whether, and to what extent, the performance of the real estate companies, can be attributed to or explained by the implementation of ESG policies at the corporate level after accounting for firm-level characteristics as well as different real estate sectors. In doing so, we examine a number of ESG aspects, examining their interrelationships with various company-level characteristics over time and across sectors in Europe and the U.K.

By utilising Bloomberg data and annual financial reports of the sample companies under investigation, the study examines key ESG attributes deemed to have significant effect on the performance of the listed real estate companies applying Pedroni's Cointegration and Granger (Wald exogeneity) Causality methods for determination of long-run cointegration and short-run causal relationships. This therefore permits insights into the ESG factors that influence the stock price performance of the listed real estate markets over time. Secondly, a number of panel regression models are constructed to investigate whether and to what degree the ESG attributes can explain the firm-level performance.

The rest of the paper is organised as follows: Section Two presents a focused literature review examining the role of ESG within listed real estate. Section Three specifies the data and methodology used within the research, with Section Four providing the key empirical results and findings. Section Six provides a discussion of the key findings with Section Seven drawing conclusions and key recommendations of the results.

Literature Review: the relationships between ESG and listed real estate

Within the real estate sector, the exponential growth of academic and industry inquiry into ESG measures and the relevance and impact on the real estate market continues. Due to long-standing concerns about the impact of real estate on the environment, the real estate investment mandate has become increasingly conscious of the interaction of ESG with listed real estate performance. Whilst there is a considerable body of international research literature which has considered various aspects of ESG measures in relation to financial performance in general, specifically that which investigates environmental aspects within the real estate sector, significant gaps remain. The evidence base of ESG investment and sustainability in the real estate sector is thin and unclear (Friede et al, 2015), the areas of social and governance are not well understood (Robinson and McIntosh 2022) and empirical questions relating to the impact of ESG related attributes on financial performance of listed European real estate companies are nascent and remain largely unanswered, particularly across diversified real estate sectors in the European markets.

Given the breadth and scope of the research, and in frontal view of the burgeoning volume of research relating ESG disclosure, transparency, financial decision-making and firm performance literature, this review is largely confined to literature which contributes to understanding of the correlation between company ESG and financial performance within real estate.

ESG and Investment in Real Estate

The spotlight on climate change and greenhouse gas emissions has fundamentally altered the public conscious and investment landscape. This is witnessed within the real estate sector where the importance of ESG measures and performance has become an emergent and important investment factor (Robinson and McIntosh, 2022), with an expanding body of research suggesting that financial markets have been increasingly cognisant of ESG aspects during the investment decision-making process, including the utilisation of non-financial data (Hudson, 2019; Cloutier, 2020). Therefore, unsurprisingly the environmental impact of real estate has promulgated an abundance of research into environmental issues, including that which has investigated real estate investment markets and engagement with the changing but related lexicon through, inter alia, Corporate Social Responsibility (CSR), Responsible Property Investment (RPI), and most recently ESG. Undoubtedly, the emerging notion of ESG within the real estate investment industry is reflected in the growing body of research which highlights, at different levels, the relationship between ESG factors and corporate performance. However, in terms of financial performance, the picture is not so clear and has been inhibited by issues relating to data availability, analytics, metrics, statistical approaches and the nature and transparency of reporting ESG measures. Therefore, notwithstanding the clear recognition the importance of ESG within real estate, the evidence relating to sustainable real estate investment remains somewhat fragmented and the impact of ESG variables on firm economic performance remains a complex and debated topic.

Financial Performance and ESG

The concept of ESG is relatively new in the REIT literature and whilst questions relating to how ESG variables impact on economic performance are not novel, they are complex. A considerable corpus of early empirical research has been undertaken in this area with mixed findings. This is reflected in the body of existing finance related research which has produced an assortment of findings and highlighted, amongst other things, that the interlink between ESG metrics and benefits within the investment universe are imbued with complexity, often intangible and difficult to quantify in both the short- and long-term (Orlitzky, Schmidt & Rynes 2003). Indeed, there is a long history of social responsibility and environmental considerations within corporate finance and the real estate sector has not been vacuous to the shifting global emphasis on climate change energy consumption and targets. As such, several studies have proceeded to investigate sustainability, ‘greenness’ and energy efficiency within the real estate investment sector, particularly, in terms of Real Estate Investment Trusts (REITs) performance (Sah, Miller & Ghosh, 2013; Devine et al., 2016; Coën et al., 2018; Eichholtz et al., 2018; Hsieh et al., 2020).

In this context, early research primarily focused on the environmental impact and sustainability on operating performance at the portfolio and asset level. For example, Eichholtz, Kok and Yonder (2012) investigated the U.S. REIT market, findings an empirical link between energy efficiency, sustainability and performance, noting that 'green' REITs performed better. Similarly, Fuerst (2015), who investigated the North American, Asia and European markets, also found that high sustainability scores resulted in enhanced performance and lower market risk. In the European context, Mariani et al. (2018) focused on the listed real estate sector and REIT sustainability, finding that REIT portfolios have a negative impact on both ROA and ROE which may be explained by incremental costs required for certification. Ooi and Dung's (2019) have also examined the role of green real estate in publicly traded REITs asset portfolios in Singapore, finding a positive significance between the 'greenness' of the portfolio and its operating performance in terms of higher returns on assets and operating margin. However, their results did highlight that higher level of green investment does not affect returns performance which they contend results due to REITs already including the impact of green investments. This is in line with Hsieh et al. (2020) who found a negative correlation between the cost of equity capital and "greenness" of the REITs. Their analysis further highlighted differences in both short- and-long-term effects with the authors suggesting that respecting community and investor need by paying high up-front development costs will eventually result in long-term financial benefits for REITs (Hsieh et al.,2020). Further, their results revealed that larger REITs tend to have more involvement in green projects, a finding which is supported by earlier research which showed a positive relationship between REIT size and institutional investment as a consequence of responsible investment practices (Frank & Ghosh, 2012).

Governance and operational efficiency

Focusing on governance, previous research which has considered the relationship between governance ratings and financial performance, applying different indicators of firm financial performance, has also produced mixed findings (Bauer, Eichholtz and Kok, 2010; Hartzell, Kallberg and Liu, 2008). Early work by Cannon and Vogt (1995) indicated that shareholder structure and involvement can impact upon returns performance. Later evidence from Bauer et al. (2010) showed that governance dimension is not related to returns performance (Tobin‟s Q, RoA, RoE) for REITs, with the authors concluding that governance is a less important factor.

In contrast, Chong et al., (2016) found that corporate governance improves performance and return on assets, finding that corporate governance is, in fact, important. Anglin et al. (2013) also investigated the relationship between corporate governance and REITs,' demonstrating that government standards create value for investors. Other studies, such as that by Laresen (2010), have considered ESG practice with some of the leading U.S. and panEurope institutional real estate open-end fund managers finding that green regulatory pressures, holistic approaches to ESG implementation and economic returns to sustainability were identified as integral to investment frameworks. More recently, Kouaib et al. (202), for the

European real estate subsector, found that good corporate governance scores improve the positive effect of the psychological bias (CEO overconfidence) on corporate performance.

Turning to operational efficiency, Berachaet et al. (2019a) undertook research to explore the impact of operational efficiency on US equity REITs on performance and stock returns. Their findings suggest that operationally efficient REITs generate better operational performance and lower risk and further that, considering the cross-section of REITs, those with higher operational efficiency outperform those with lower efficiency in terms of cumulative stock returns. Similarly, subsequent research Berachaet et al.(2019b) revealed that a higher operational efficiency predicts higher firm value. Aroul, Sabherwal and Villupuram, (2022) have also examined the relationship between ESG, REITs and their operational efficiency and performance. Their study found that REITs with higher ESG scores have higher operational efficiency and performance.

An interesting body of work has also investigated the linkage between ESG performance and the impact of the Covid-19 pandemic on the stock performance of listed firms in Europe (Hoang, Segbotangnib and Lahianic, 2021)**.** The empirical results from this study indicate that firms with high ESG performance have a lower volatility than those with low ESG performance in both periods. However, there is no evidence that the stock performance is higher for firms with high ESG performance. On the other hand, the findings identified the need to carefully consider ESG ratings and also found a significant impact of Covid-19 factors on stock performance and that sectoral and country effects were significant during the Covid-19 pandemic. Similar research by Abedifar et al. (2022) has examined whether environmental and social activities impacted the resiliency of firms in developed countries during the COVID-19 crisis. Their analysis suggests that engaging with ES activities is not associated with a better or worse performance during crisis times. Other research in this area by Fambo and Cok (2022) correlates stock valuation and stock performance during the 2020 stock market crash with the ESG score—and its components across listed firms. The findings show that high-ESG stocks do slightly better than average and support the proposition that ESG investing represents a solid portfolio strategy, even during market crashes and economic downturns. They also conclude that the effect of ESG component scores should be taken into account when using ESG indexes as investment clues but caution that the relation between ESG risk scores and stock performance and valuation is complex and requires further research.

ESG Disclosure and transparency

For REITs, ESG disclosure has clearly become a critical issue for their investors and industry. Despite the increasing focus on REIT ESG disclosure, research on how it influences firm performance and value remains embryonic and inconclusive, primarily due to data exigencies, differences in ESG criteria and overall disagreement across ESG data providers on quality, measurement and ratings (Christensen et al., 2021). That said, a growing volume of research has investigated the how ESG disclosure may affect firm value and performance. Chiang et al. (2017) investigates REITs to explore, amongst other things, whether disclosure can have a significantly positive relation with firm performance. Findings from this research suggests that disclosure has a positive association with the cost of capital in terms of both risk mitigation and incentivisation. Further research has found comparable results in this strand.

A recent study by Feng and Wu (2021) examined how ESG disclosure is related to REIT debt financing and firm value. The authors found that REITs with better ESG disclosure have a lower cost of debt and higher credit ratings, suggesting improved ESG disclosure facilitates improved access to capital markets. In a similar study of European public real estate firms, Brounen et al. (2021) investigated whether ESG performance and completeness are positively correlated and found that investors are willing to pay a premium for firms with higher sustainable ratings.

Other research has developed this and investigated whether or not there is a correlation between the real estate company's ESG disclosure score in developed markets with their financial performance. Almeyda and Darmansyah (2019) found that there is a statistically significant positive relationship between the ESG disclosure with firm's ROA and ROC, but no significant relationship with Stock Price and P/E. Overall, their findings show that a high transparency regarding ESG information could improve the financial performance. An et al. (2011) have also investigated and found that corporate transparency is positively associated with REIT growth, arguing that greater transparency reduces information-based constraints on external financing. Other research has noted that ESG information asymmetry of REITs is relatively low when they access the capital markets (Devos et al., 2019). These findings indicate that REITs increase their disclosure of ESG aspects to raise capital from markets. Chiang et al. (2019) also find that REITs disclose more CSR information when they have more investment opportunities. Taken together, these findings indicate improvements in transparency and ESG disclosure levels have been correlated to increased returns in REITs and has benefits for investment and lending decisions by allowing for enhanced financial flexibility and improved access to capital markets.

ESG disclosure and data transparency have also been the subject of increasing regulatory attention and scrutiny. Some research indicates that corporate engagement and disclosure can contribute to sustainability and financial performance and mitigate risk (Beck et al., 2018; Krueger et al., 2021). The work of Yu, Guo, and Luu (2018) further suggests that the benefits of ESG disclosure outweigh its costs for listed companies. These authors also point out that a greater ESG data transparency reinforces the valuation ratios of firms, such as Tobin's Q. Moreover, ESG transparency provides additional information to accounting data. This, it is argued, helps to mitigate the information asymmetry between firms and its stakeholder. In this context, Hammami and Zadeh (2019) identify two main drivers of ESG data transparency which are audit quality and corporate public media exposure. As a result, ESG transparency promotes a better resource allocation.

However, other research, such as that by Cordazzo, Bini, and Marzo (2020), reveals that the disclosure of non-financial information which aggregates ESG does not provide any value enhancing performance where firm information disclosure is *de minimis*. These findings are somewhat supported by the work of Cek and Eyupoglu (2020) who argue that social and governance performance significantly affect economic performance which may be the result of variability within disclosure levels of ESG domains (Tamimi and Sebastianelli, 2017), where governance seems to present the highest level of transparency, while the lowest transparency is for the environmental domain. Furthermore, in general, the literature also suggests that industry sector appears to be an influential factor in determining the extent of ESG data reporting and disclosure on corporate sustainability practices (Bonson and Bednarova, 2015). According to these authors, the sector effect influences both the overall ESG performance and each of the ESG factors studied. Depending on the industry sector, ESG factors do not have the same levels of transparency at the firm level. Notably, Tamimi and Sebastianelli (2017) also showed significant differences in ESG disclosure transparency among industry sectors. This is problematic and, considering the above, highlights that the underpinning issues of ESG have often been examined independently or without full transparency or proper investigation of interlinkages, thereby limiting the extent of the empirical evidence within the real estate literature on the impact of ESG on listed real estate.

Data and Methodology

The sample of stock markets utilised within this study are derived from Bloomberg for the listed real estate markets within the U.K., France, Netherlands, Germany, Sweden and Switzerland. These markets have been selected primarily on the basis of their maturity of ESG development, data availability as well as market capitalisation, liquidity, sectoral diversity and transparency. ESG attributes that are considered relevant to financial performance of listed real estate include (i) energy usage, (ii) GHG emissions, (iii) water consumption, (iv) policy on green certified buildings, (v) gender diversity, (vi) health and safety of employees and buildings, (vii) communities engagement, (viii) corporate policies and governance obtained from Bloomberg over the period 2010-2022. In total, 61 listed real estate firms are examined, which are tracked by the indexes of EPRA (European Public Real Estate Association). In relation to data on ESG, it is worth emphasising that they are categorised into (i) disclosure and (ii) performance attributes. The former measures the degree of transparency of the company in revealing their ESG standards over a financial year, whereas the latter, known as BESG pillar score/percentile indicates the actual ESG performance of the company as measured by Bloomberg. **Table 1** below depicts the definitions of the financial attributes as well as the ESG variables under investigation in the study, which are provided by Bloomberg.

Table 1: Description of the variables

	Variable	Definition
Dependent Variables	Raw Return (RAW)	Defined as the year-on-year return of the stock before tax
	Sharpe Ratio (Sharpe)	Defined as the year-on-year return of the stock divided by the standard deviation of the quarterly returns over a one year period.
	Tobin's q	Ratio of the market value of a firm to the replacement cost of the firm's assets. The Q ratio is useful for the valuation of a company. It is based in the hypothesis that in the long run the market value of a company should roughly equal the cost of replacing the company's assets.
Financial Variables	Market Capitalisation (CAP)	Monetary value of all outstanding shares stated in the pricing currency. Capitalization is a measure of corporate size.
	Loan to Value (LTV)	Leverage ratio in percentage that defines the total amount of debt relative to assets. This enables comparisons of leverage to be made across different companies. Calculated as: Total Debt x 100 / Total Assets
	Growth in Revenue (REV)	The year-on-year rate of change in revenue, which is defined as the amount of sales generated by a company after the deduction of sales returns, allowances, discounts, and sales based taxes.
	Return on Common Equity (ROE)	It is a measure of a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested, in percentage. It is defined as net income available for common shareholders divided by average total common equity.
	Dividend Yield (DY)	Sum of gross dividend per share amounts that have gone ex-dividend over the prior 12 months, divided by the current stock price.
ESG Variables	Inverse of Energy Consumption per Market Cap (INV_ENERGY)	The inverse of total Energy Consumption in thousands of megawatt hours (MWh) divided by market cap. This includes energy directly consumed through combustion in owned or controlled boilers, furnaces, vehicles, or through chemical production in owned or controlled process equipment. It also includes energy consumed as electricity.
	Greenhouse Gas Emission per Market Cap(INV_GHG)	The inverse of total emission of greenhouse gas (GHG) per market cap, if available, otherwise total carbon dioxide (CO_2) emissions in millions of metric tonnes.

		Total GHG emissions is the sum of Scope 1 GHG emissions + Scope 2 GHG emissions Total CO2 emissions is the sum of Direct CO2 Emissions + Indirect CO2 Emissions
	Water Consumption per Market Cap (WATER)	Total amount of water per market cap used to support a company's operational processes, in thousands of cubic meters.
	Percentage of Women in Workforce (WOMEN)	Number of women employed at the company expressed as a percentage of the total number of company employees.
	Health and Safety Policy (HS)	Indicates whether the company has at policy level recognized its health and safety risks and responsibilities and is making any effort to improve the management of employee health and/or employee safety. It is a binary dummy variable equal to one if such policy exists, zero otherwise.
	Green Certified Building (GCB)	Indicates whether the company has developed a policy that recognises the importance of building energy efficiency. It is a binary dummy variable equal to one if such policy exists, zero otherwise.
	Community Spending per Market Cap (COMMUNITY)	Amount of money per market cap spent by the company on community-building activities, in millions. This includes both cash and in-kind donations if given in a monetary value, and excludes employee contributions and money raised through events.
	Governance Disclosure Score (GDS)	Proprietary Bloomberg score based on the extent of a company's Governance data disclosure, as a pillar of Environmental, Social and Governance (ESG) data. The score ranges from 0 for companies that do not disclose any of the Governance data included in the score, to 100 for those that disclose every data point. This score measures the amount of Governance data a company reports publicly, and does not measure the company's performance on any data point.
	Social Disclosure Score (SDS)	Proprietary Bloomberg score based on the extent of a company's Social data disclosure, as a pillar of Environmental, Social and Governance (ESG) data. The score ranges from 0 for companies that do not disclose any of the Social data included in the score, to 100 for those that disclose every data point. This score measures the amount of Social data a company reports publicly, and does not measure the company's performance on any data point.
	Environmental Disclosure Score (EDS)	Proprietary Bloomberg score based on the extent of a company's Environmental data disclosure, as a pillar of Environmental, Social and Governance (ESG) data. The score ranges from 0 for companies that do not disclose any of the Environmental data included in the score, to 100 for those that disclose every data point. This score measures the amount of Environmental data a company reports publicly, and does not measure the company's performance on any data point.
	ESG Disclosure Score (ESGDS)	Proprietary Bloomberg score based on the extent of a company's ESG data disclosure, as a pillar of Environmental, Social and Governance (ESG) data. The score ranges from 0 for companies that do not disclose any of the ESG data included in the score, to 100 for those that disclose every data point. This score measures the amount of ESG data a company reports publicly, and does not measure the company's performance on any data point.
	BESG Environmental Pillar Percentile (BEP)	Bloomberg Environmental and Social scoring peer group percentile ranking based on the proprietary Bloomberg Environmental score. Values are 0-100%.
	Bloomberg's Social Pillar Score (BSPS)	Proprietary Bloomberg score ranging from 0 to 10 evaluating the company's aggregated Social performance.
	BESG Governance Pillar Percentile (BGP)	Bloomberg Environmental, Social and Governance (ESG) scoring peer group percentile ranking based on the proprietary Bloomberg Governance pillar score. Values are 0-100%.

The quantitative analysis of this study consists of two main components. First we test whether, and to what extent, the performance of the companies, measured by *raw return, Sharpe and Tobin's q*, can be attributed to or explained by the implementation of ESG policies at the corporate level after accounting for firm-level characteristics including but not limited to market capitalisation, leverage ratio (LTV), ownership characteristics, return on equity, revenue, dividend yields etc. Secondly, we determine whether the ESG attributes are cointegrated with the performance of the companies and whether there is a lead-lag relationship between the two groups of variables.

Cointegration and causal effects

To econometrically explore the ESG performance drivers that affect each listed real estate submarket, cointegration and causality testing will be undertaken. Return/performance (R) will be examined for the sample listed real estate company, alongside time series for the ESG variables ($ESG, ESG_2, \ldots \ldots ESG_n$). In our study, the subsets of ESG include (i) inverse of energy usage per market cap, (ii) inverse of GHG emissions per market cap, (iii) inverse of water consumption per market cap, (iv) green certified buildings, (v) gender diversity, (vi) health and safety of employees and buildings, (vii) communities engagement, (viii) corporate policies and governance. It should be highlighted that inverse operator is employed on some of the abovementioned variables as it would make interpretation of results more straightforward, that is to examine whether or not a reduction in the consumption of resources (e.g. energy and water) could lead to an enhanced financial performance. Prior to undertaking the cointegration and causality tests, we conduct IPS tests to check for unit roots within the time series. Differencing is applied to the time series based on the results of the unit root test.

To determine whether long term equilibrium relationships exist between each pair of R and ESG, we utilise the Cointegration method for panel data developed by Pedroni (2004) which is mathematically represented by the equation below:

$$R_{it} = \alpha_i + \sum \beta_{ji} ESG_{jit} + e_{it} \ldots\ldots \text{(Equation 1)}$$

where e_{it}=$p_i e_{i(t-1)}$+w_{it} is the estimated residual from the panel regression. The Pedroni's method considers seven test statistics, which are based upon the estimated residuals of the above long run model, with the null hypothesis being no cointegration in the heterogeneous panels. The first set of tests are called "within dimension" (i.e. panel tests) whereas the other is known as "between dimension" (i.e. group tests). The former takes into consideration common temporal factors and allows for heterogeneity across members. On the other hand, the latter allows for heterogeneity of parameters across members. The seven statistics of Pedroni's are normally distributed with the null hypothesis of p_i being unity. If the statistics is greater than the appropriate critical values, then the null hypothesis of no integration between the variables should be rejected.

Once a cointegration relationship between a pair of variables is established, panel causality tests developed by Holtz-Eakin et al. (1988) can be carried out to detect any lead-lag relationship between the time series in question. Their time-stationary VAR model is given by:

$$R_{it} = \alpha_0 + + \sum_{j=1}^{m} \alpha_i R_{it-i} + \sum_{j=1}^{m} \gamma_j ESG_{it-j} + f_{xi} + u_{it}$$

$$ESG_{it} = \beta_0 + + \sum_{j=1}^{m} \beta_i R_{it-i} + \sum_{j=1}^{m} \delta_j ESG_{it-j} + f_{xi} + v_{it} \ldots\ldots \text{(Equation 2)}$$

where i= 1, 2, 3,…, n represents cross-sectional panel members for the sample listed companies, and u_{it} and v_{it} are the residual terms for the equations. f_{yi} and f_{xi} captures the fixed effects for the panel member i. However, since the lagged dependent variables are likely correlated with the residuals and terms on the fixed effects, the estimates of the above equations could be biased under OLS. Therefore, we remove the fixed effects by differencing, which yields the following equations:

$$\Delta R_{it} = \sum_{j=1}^{m} \alpha_j \, \Delta R_{it-j} + \sum_{j=1}^{m} \gamma_j \, \Delta ESG_{it-j} + \Delta u_{it}$$

$$\Delta ESG_{it} = \sum_{j=1}^{m} \beta_j \, \Delta R_{it-j} + \sum_{j=1}^{m} \delta_j \, \Delta ESG_{it-j} + \Delta v_{it} \ldots\ldots \text{(Equation 3)}$$

It should be noted that after differencing, an issue of simultaneity could arise given that the correlation between the lagged endogenous variables and the differenced error term. Furthermore, the error terms could be heteroscedastic since heterogeneous errors might be present across different panel members. To overcome these problems, we employ an instrumental variable estimation procedure to estimate the models, which should produce more consistent estimates of the coefficients. According to Easterly et al. (1997), the second or more lagged values of the variables might be utilised as instruments assuming that u_{it} and v_{it} are not serially correlated. The joint hypothesis γ_j =0 and β_j=0 is tested to determine whether causality exists. The Generalised Method of Moments (GMM) is used to estimate the equations for its superior efficiency and consistency compared to other estimation procedures. (Arellano and Bond, 1991). The test statistics follow a Chi-squared distribution with the degree of freedom equal to k-m, where k is the number of regressors.

Company-level performance and ESG

We also explore how company-level ESG attributes affect performance of the sample real estate companies within a panel data framework. Tobin's q ($Q_{i,t}$) (alongside raw return and risk-adjusted return) is used as the principal measure for gauging a firm's (i) performance at time t, which is commonly defined as the ratio of the market value of a company's equity and liabilities to its corresponding book values. Mathematically, it is given by:

$$Tobin's\ q\ (Q_{i,t}) = \frac{Equity\ Market\ Value + Liabilities\ Market\ Value}{Equity\ Book\ Value + Liabilities\ Book\ Value} \text{ ----- (Equation 4)}$$

Historically, firms with high Tobin's q have been found to be more favourable investment opportunities (Lang, Stulz and Walkling'1989; Lang and Stulz, 1994) or exhibit better growth potential (Brainard and Tobin, 1968; Tobin, 1969). In order to test whether, and to what degree, company-specific attributes affect the firm's performance, an equation linking the performance indicators and a spectrum of company-level attributes is estimated (see Equation 5 below). The attributes to be examined include (1) the market capitalisation of the company (*Cap*), which is measured by the multiplication of share price and number of shares outstanding; (2) leverage ratio (*L*), which is defined as debt/equity; (3) dividends (*D*), which can be represented by total dividends over earnings in a given financial year; (4) ownership (O), which captured the shareholding ratio of the largest owner of the firm; (5) return on equity (*ROE*), which measures the profitability of the company, (6) corporate structure (*V*), which is a binary variable equal to one if the company in question is a REIT, zero otherwise.

$$Q_{i,t} = \text{c} + Cap_{i,t} + L_{i,t} + D_{i,t} + O_{i,t} + ROE_{i,t} + V_{i,t} + ESG_{i,t} + \sum C + \text{e----- (Equation 5)}$$

where c is a constant and $\sum C$ is a spectrum of control variables, including the business focus of the firm, country of domicile and sector of the firm etc.. We develop three sets of models based on Equation 4 with each set focussed exclusively on one performance indicator. Within each set of models, 14 equations are derived with each equation examining one ESG attribute in addition to the control variables (Models 1-14 for raw return; Models 15-28 for Sharpe ratio; and Models 29-42 for Tobin's q). All tests are conducted on a quarterly basis.

Empirical Results and Findings

The results of the IPS unit root tests are presented in **Table 2**. All time series under investigation, with the exception of INV_ENERGY, are non-stationary at level but stationary at first difference. Therefore, we treat them as *I*(I) accordingly for the subsequent statistical tests.

Table 2: Results of IPS Unit Root Tests

Variable	Level	First Difference
RAW	0.55087 (0.7091)	-3.78474 (0.0001)***
Sharpe Ratio	0.01008 (0.5040)	-2.77396 (0.0028)***
Tobin's q	0.43124 (0.6669)	-3.41874 (0.0003)***
INV_ENERGY	-5.48765 (0.0000)***	-9.02406 (0.0000)***
INV_GHG	3.40552 (0.9997)	-14.0248 (0.0000)***
INV_WATER	1.59188 (0.9443)	-13.9253 (0.0000)***
COMMUNITY	1.03072 (0.8487)	-11.3965 (0.0000)***
WOMEN	3.20787 (0.9993)	-4.14094 (0.0000)***
GDS	3.90123 (0.9996)	-3.34745 (0.0004)***
EDS	-0.55571 (0.2892)	-2.26700 (0.0117)**
SDS	3.21831 (0.9994)	-5.39253 (0.0000)***
ESGDS	2.10196 (0.9822)	-5.85027 (0.0000)***
BEP	3.04196 (0.9988)	-3.21060 (0.0007)***
BSPS	0.76376 (0.7775)	-11.5122 (0.0000)***
BGP	-1.64515 (0.0501)*	-14.6606 (0.0000)***

Notes: "**" and "***" indicate statistical significance at the 5% and 1% level respectively.

Table 3 reports the results of the Pedroni cointegration tests for raw return, Sharpe ratio and Tobin's q respectively. The tests are conducted based on the rule that the *null* hypothesis of no cointegration between a given pair of time series is rejected if the test statistics have large negative values, except for the panel-v test which rejects the null when the test statistics is a large positive value. Examination of the results of the seven statistics for each pair of time series reveals that all financial and ESG attributes are cointegrated with the performance attributes, except for WOMEN, and GB which are not cointegrated with Sharpe, and COMMUNITY which shows no long-run cointegrating relationship with Tobin's q. Hence, we conduct the Causality tests within the framework of Error Correction Model for the pairs of time series that are cointegrated.

Table 3: Results of Pedroni, Raw Return, Sharpe and Tobin's q Cointegration Tests

Pedroni (Raw return)							
Variable	Panel v-stat	Panel rho -stat	Panel PP-stat	Panel ADF-stat	Group rho -stat	Group PP-stat	Group ADF-stat
INVERSE_ENERGY	4.961851***	-14.49582***	-14.15429***	-3.667830***	-3.536743***	-9.884836***	-5.030905***
INVERSE_GHG	4.885870***	-16.09411***	-14.83958***	-3.982701***	-3.594124***	-10.26343***	-5.050540***
INVERSE WATER	5.392771***	-9.783302***	-8.859877***	-3.407027***	-2.829849***	-8.677923***	-3.802968***
COMMUNITY	2.638117***	-12.24137***	-10.65560***	-1.752451***	-3.582676***	-7.994139***	-3.441526***
WOMEN	4.248166***	-10.53268***	-9.936824***	-5.818916***	-4.275208***	-10.80014***	-6.482060***
HS	2.147801***	-6.945235***	-6.520084***	-4.154349***	-3.518788***	-6.659451***	-4.467325***
GB	4.929235***	-14.23138***	-13.69542***	-5.251061***	-5.086571***	-9.112920***	-4.572349***
GDS	7.057157***	-17.76149***	-17.80698***	-7.995615***	-8.649291***	-14.40139***	-7.688290***
EDS	6.543808***	-18.31454***	-18.12008***	-7.519512***	-8.160851***	-14.81338***	-7.258488***
SDS	7.212451***	-18.29427***	-17.90532***	-7.660302***	-8.131161***	-15.28099***	-8.025656***
ESGDS	7.232645***	-18.36516***	-17.80098***	-7.866673***	-8.635754***	-14.89520***	-8.130640***
BEP	2.781172***	-4.997378***	-7.588838***	-3.407959***	-2.025403**	-7.539289***	-3.183095***
BSPS	1.914807**	-4.536546***	-6.751400***	-3.551076***	-1.728825**	-7.117204***	-3.582663***
BGP	3.918453***	-5.095693	-7.474623***	-3.887343***	-1.917408**	-6.793881***	-3.264080***
Pedroni (Sharpe)							
Variable	Panel v-stat	Panel rho -stat	Panel PP-stat	Panel ADF-stat	Group rho -stat	Group PP-stat	Group ADF-stat
INVERSE_ENERGY	-0.266405	-12.89546***	-13.39122***	-6.602417***	-4.969441***	-13.31433***	-5.706569***
INVERSE_GHG	-1.075042	-14.19840***	-14.16215***	-6.909286***	-5.133955	-14.37394***	-5.344377***
INVERSE_WATER	4.093882***	-0.521674	-5.260852***	-0.421004***	3.771559***	0.237288***	3.520045***
COMMUNITY	-0.412708	-7.916270***	-8.088774***	-2.734484***	-3.000465***	-7.816732***	-2.411231***
WOMEN	2.310695**	4.247619	5.403138	2.789476	6.191534	4.974562	2.407226
HS	1.472522*	-9.780457***	-9.131266***	-3.118105***	-5.432764***	-8.978333***	-2.868031***
GB	-253.6767	0.937300	0.607919	1.354942	2.661437	-0.045598	0.373041
GDS	1.045533	-16.81451***	-16.23897***	-8.147459***	-10.30364***	-16.70505***	-7.617866***
EDS	1.744917	-17.69740***	-16.61820***	-8.191299***	-9.881560***	-16.56995***	-7.191418***
SDS	4.459838***	-17.72278***	-17.69191	-9.464117***	-9.954844***	-18.55481***	-8.152008***
ESGDS	3.980744***	-18.54376***	-17.64731***	-9.089130***	-10.40025***	-16.96113***	-7.804019***
BEP	-1.028895	-7.488767***	-13.68600***	-5.251687***	-3.866806***	-13.76834***	-4.923891***
BSPS	-2.467428	-6.758888***	-11.72462***	-4.333084***	-3.090067***	-11.28121***	-3.820392***
BGP	-1.234591	-7.298124***	-12.19066***	-4.281772***	-3.717244***	-12.00026***	-4.198598***
Pedroni (Tobin's q)							
Variable	Panel v-stat	Panel rho -stat	Panel PP-stat	Panel ADF-stat	Group rho -stat	Group PP-stat	Group ADF-stat
INVERSE_ENERGY	0.768347	-3.567745***	-4.905063***	-5.375473***	1.107657	-4.787800***	-7.029965***
INVERSE_GHG	0.530576	-3.408542***	-4.402241***	-4.494765***	1.716345	-3.833505***	-5.491791***
INVERSE_WATER	0.487219	-1.909946**	-3.973618***	-4.276206***	1.617430	-3.655706***	-4.918971***
COMMUNITY	0.186625	0.264957	0.864093	-4.334487***	2.417293	0.733808	-4.344244***
WOMEN	-106.7092	-1.936919**	-5.157720***	-6.076800***	1.648309	-5.499639***	-10.49303***
HS	1.156184	-4.601900***	-7.734770***	-2.207402**	-0.382772	-3.343240***	-4.114924***
GB	0.426960	-3.136217***	-4.396085***	-4.463930***	0.661529	-2.804239***	-6.588585***
GDS	-0.570793	-5.221025***	-8.899903***	-4.871056***	0.223478	-4.921741***	-9.302144***
EDS	0.252558	-6.474199***	-10.52041***	-6.968906***	0.228909	-6.808075***	-10.97716***
SDS	0.053867	-6.248042***	-9.666790***	-5.638998***	0.639105	-5.377254***	-9.695557***
ESGDS	-0.164855	-6.370671***	-9.915386***	-6.242739***	0.388016	-6.140839***	-10.10982***
BEP	0.730898	-7.233647***	-11.46065***	-6.072666***	0.744856	-4.104052***	-11.06625***
BSPS	7.054041***	-6.415687***	-10.53495***	-5.689481***	0.851706***	-4.483679***	-11.56282***
BGP	2.287077	-7.785140***	-12.49268***	-7.237878***	0.721401	-4.165161***	-12.32620***

Notes: "*", "**" and "***" indicate statistical significance at the 10%, 5% and 1% level respectively.

GMM Estimation and Causality Results

The overall results of the Granger causality tests on the ESG attributes and performance time series are summarised and presented in **Table 4**, with full model outputs observable in

Appendix 1[2]. A number of noteworthy and interesting findings can be observed across the attributes examined. First, the inverse of energy use per market cap Granger-causes raw return and Sharpe ratio in the long term, implying that a reduction in energy use at corporate level could lead to better financial performance. Bi-directional short-term causality is also detected when Tobin's q is used as the performance indicator, despite the long-term lead-lag relationship being statistically insignificant.

Table 4: Summary of Panel data causality tests

	Y					
	Raw		Sharpe		Tobin's q	
Causality	Short term	Long Term	Short term	Long Term	Short term	Long Term
INV_ENERGY →Y	No	No	No	No	No	No
Y→ INV_ENERGY	Yes	Yes	No	No	Yes	No
INV_GHG→Y	No	No	No	No	No	No
Y→ INV_GHG	Yes	Yes	Yes	Yes	No	Yes
INV_WATER→ Y	Yes	No	Yes	No	No	No
Y→ INV_WATER	No	No	No	No	No	No
WOMEN→Y	Yes	Yes	Yes	N o	Yes	No
Y→WOMEN	Yes	Yes	No	No	No	Yes
COMMUNITY → Y	No	No	No	No	No	No
Y→ COMMUNITY	No	No	No	No	No	No
EDS→ Y	No	Yes	No	Yes	No	Yes
Y→ EDS	Yes	Yes	No	Yes	Yes	No
SDS→ Y	No	Yes	No	Yes	No	No
Y→ SDS	No	No	No	No	No	No
GDS→ Y	No	Yes	No	Yes	No	Yes
Y→ GDS	No	Yes	Yes	Yes	No	Yes
ESGDS→ Y	No	Yes	No	Yes	No	No
Y→ ESGDS	Yes	Yes	No	Yes	No	No
BEP→ Y	No	Yes	No	Yes	No	No
Y→ BEP	Yes	No	Yes	No	No	Yes
BSPS→ Y	No	Yes	No	Yes	No	No
Y→ BSPS	No	No	No	Yes	No	Yes
BGP→ Y	No	Yes	No	Yes	No	No
Y→ BGP	No	No	No	No	No	No

[2] We present the Chi-square and the corresponding probability for the Wald test on the coefficient restriction, the coefficient on the error correction term alongside its corresponding t-statistics and probability, as well as the coefficients on the lagged terms for the long-term causality. The 95% confidence interval is used to determine the statistical significance of the variables across two time lag intervals, *t*-1 and *t*-2.

Second, we do not find any statistically robust evidence that suggests a reduction in GHG emission could lead to superior financial performance in the real estate sector based on the results of the causality tests. However, the opposite causation seems to hold across all performance indicators. In other words, a growth in financial performance is likely to result in real estate firms adopting measures to reduce GHG emission.

Third, water consumption per market cap does not seem to have any significant causal association with company's performance. The findings of the causality tests for this attribute only reveal raw return exhibiting a short-term impact with other performance indicators displaying insignificant statistical relationships with it both in the short- and long-run. Fourth, gender diversity, measured by the percentage of women in workforce Granger-causes raw return and Tobin's q in the long-run. Indeed, the attribute is Granger-caused by the performance variables in both the long- and short-run, confirming a bi-directionality of the causal linkages. Fifth, the amount of community spending per market cap is found to have no statistically significant causal relationship with any of the three performance variables, both in the short and long-run and across the time lags examined.

We further investigate the three disclosure scores of the ESG aspects of the sample companies and their lead-lag interaction with the performance attributes. It is discernible from the results that environmental disclosure scores do have a significant causal impact on the performance of firm in the long-run, with the environmental attribute Granger-causing the time series on raw return, Sharpe ratio as well as Tobin's q. For the reverse causation, we observe that raw return and Sharpe ratio leads the disclosure score in the long-run, whilst a higher raw return and Tobin's q tend to increase the disclosure score in the short-run.

In relation to social disclosure score, it is found to Granger-cause raw returns and the Sharpe ratio, but not the Tobin's q in the long-run. Further, the governance disclosure score exhibits a long-term bi-directional causal link with all the three performance indicators. On the other hand, the aggregate ESG disclosure is observed to have bi-directional causal interconnections with raw return and Sharpe ratio, but not with Tobin's q in the long-run.

Last but not least, it is evident from the results that over a longer time horizon, BEP, BSPS and BGP all Granger-cause raw return and Sharpe, but not Tobin's q, seemingly implying that companies that work on improving ESG development might generate superior returns in the long-run. It is further noteworthy that Sharpe and Tobin's q Granger-cause BEP and BSPS, signalling the inclination of some real estate firms that when they have achieved better financial performance, they are indeed willing to allocate more resources to enhance the environmental and social standards within their organisations.

Panel Regression Models

In addition to the abovementioned Cointegration and Causality Models, we develop 42 panel regression models to examine the effect of the various ESG attributes on the performance of the listed real estate companies (**Table 5**). The analysis reveals that a majority of ESG attributes do not exhibit any statistically significant negative effects on raw return, Sharpe, and Tobin's q with the exceptions of INV_WATER, GDS and BGP which are found to depress the magnitude of Tobin's q.

Table 5: Results of panel regression models (raw return, Sharpe, Tobin's q)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Constant	-13.89175 (0.3046)	-23.11901 (0.1142)	-25.19074 (0.0890)*	-45.64114 (0.0728)*	-20.53027 (0.0827)*	-19.52379 (0.1164)	-22.48437 (0.1439)	-20.79292 (0.0598)*	-21.86783 (0.0991)*	-27.81223 (0.0449)**	-24.30221 (0.0356)**	-30.75262 (0.1727)	-34.93520 (-1.511511)	-38.42579 (0.0758)*
Market Cap	0.342400 (0.5319)	0.649695 (0.2597)	0.926235 (0.1615)	1.534630 (0.1389)	0.683580 (0.1590)	0.558007 (0.2827)	0.869047 (0.1536)	0.911983 (0.0644)*	0.713495 (0.2039)	0.980162 (0.0908)*	0.942310 (0.0739)*	1.508462 (0.1225)	1.566018 (0.1078)	2.259560 (0.0192)**
LTV	0.164562 (0.0050)***	0.158410 (0.0082)***	0.122736 (0.0314)**	0.174063 (0.0684)*	0.145359 (0.0006)***	0.144188 (0.0006)***	0.177598 (0.0005)	0.167891 (0.0000)***	0.154914 (0.0005)***	0.160814 (0.0003)***	0.164922 (0.0001)***	0.331745 (0.0055)***	0.364667 (0.0025)**	0.342910 (0.0021)***
ROE	0.244931 (0.0001)***	0.305112 (0.0000)***	0.284137 (0.0000)***	0.299289 (0.0017)***	0.202581 (0.0006)***	0.241321 (0.0001)***	0.210317 (0.0020)***	0.221331 (0.0003)***	0.208388 (0.0004)***	0.199999 (0.0007)***	0.213870 (0.0000)***	0.236725 (0.0267)**	0.222862 (0.0453)**	0.263940 (0.0053)***
REV Growth	0.007285 (0.7329)	0.019279 (0.3919)	0.014287 (0.4541)	0.048261 (0.1543)	0.023530 (0.1696)	0.026202 (0.1292)	0.036003 (0.1665)	0.016972 (0.2979)	0.021949 (0.2242)	0.020069 (0.2624)	0.017707 (0.1671)	0.017301 (0.4914)	0.017216 (0.5115)	0.016951 (0.4786)
Dividend Yield	-1.591169 (0.0000)***	-1.605475 (0.0000)***	-1.570282 (0.0000)***	-1.274014 (0.0002)***	-1.614639 (0.0000)***	-1.594041 (0.0000)***	-1.609656 (0.0000)***	-1.628702 (0.0000)***	1.616601 (0.0000)***	-1.637599 (0.0000)***	-1.635140 (0.0000)***	-1.728183 (0.0000)***	-1.793505 (0.0000)***	-1.510434 (0.0000)***
INV_ENERGY	6.01E-07 (0.3455)													
INV_GHG		2.04E-08 (0.7625)												
INV_WATER			3.06E-06 (0.1013)											
COMMUNITY				-935.3649 (0.7954)										
GB					-1.053291 (0.2022)									
HS						0.897804 (0.4369)								
WOMEN							-0.065290 (0.0592)*							
GDS								-0.088075 (0.0512)*						
SDS									-0.024623 (0.5567)					
EDS										-0.043837 (0.1385)				
ESGDS											-0.077881 (0.0887)*			
BEP												-0.771603 (0.1578)		
BSPS													-0.571721 (0.1045)	
BGP														-1.736879 (0.0079)***
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
REIT dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1217	1206	915	559	1608	1612	1381	1667	1640	1640	1667	732	719	780
Periods	46	46	46	46	46	46	46	46	46	46	46	28	28	28
Crosssections	50	53	44	23	56	56	53	55	55	55	55	36	36	36
R2	0.725457	0.711656	0.719903	0.756385	0.713294	0.714353	0.710526	0.712357	0.711206	0.711554	0.711896	0.721004	0.721684	0.724135
Adj R2	0.709953	0.695215	0.699167	0.725933	0.701208	0.702343	0.696217	0.700678	0.699280	0.699643	0.700573	0.702268	0.702633	0.706823
Prob(F)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
DW	1.968130	1.901494	1.917937	1.883144	1.951210	1.932767	1.923138	1.946067	1.947700	1.947541	1.946474	1.918658	1.924496	1.919869

	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28
Constant	-3.460315 (0.0409)**	-3.313391 (0.0443)**	-4.285018 (0.0171)**	-7.457124 (0.0401)**	-3.509055 (0.0183)**	-3.509055 (0.0183)**	-3.269319 (0.0642)*	-3.171829 (0.0263)**	-3.745633 (0.0282)**	-2.744717 (0.1116)	-3.040234 (0.0500)**	-0.695350 (0.7929)	-1.263659 (0.6381)	-0.896473 (0.7169)
Market Cap	0.124894 (0.0613)*	0.104446 (0.1173)	0.143833 (0.0763)*	0.284054 (0.0537)*	0.121611 (0.0469)**	0.121611 (0.0469)**	0.105604 (0.1557)	0.123684 (0.0519)*	0.135769 (0.0611)*	0.087336 (0.2231)	0.095144 (0.1783)	0.082051 (0.4849)	0.085611 (0.4712)	0.096111 (0.3748)
LTV	0.013404 (0.0742)*	0.013263 (0.0305)**	0.009250 (0.2513)	0.024501 (0.0662)*	0.014308 (0.0044)***	0.014308 (0.0044)***	0.016297 (0.0056)***	0.014532 (0.0039)***	0.015025 (0.0052)***	0.014021 (0.0095)***	0.013539 (0.0124)**	0.017109 (0.1280)	0.021710 (0.0458)**	0.023113 (0.0222)**
ROE	0.037286 (0.0000)***	0.034210 (0.0001)***	0.044880 (0.0000)***	0.054159 (0.0000)***	0.032475 (0.0000)***	0.032475 (0.0000)	0.033787 (0.0001)***	0.033855 (0.0000)***	0.032646 (0.0000)***	0.033598 (0.0000)***	0.034047 (0.0000)***	0.030898 (0.0118)**	0.034335 (0.0068)***	0.029999 (0.0076)***
REV Growth	0.000951 (0.6868)	0.000773 (0.6909)	0.000934 (0.7291)	0.001922 (0.6258)	0.002398 (0.1640)	0.002398 (0.1640)	0.001276 (0.5607)	0.001489 (0.3998)	0.001541 (0.4036)	0.001866 (0.3150)	0.001770 (0.3136)	0.002327 (0.4079)	0.001383 (0.6173)	0.003104 (0.2541)
Dividend Yield	-0.081177 (0.0063)***	-0.076377 (0.0073)***	-0.062967 (0.1331)	-0.119091 (0.0109)**	-0.083829 (0.0026)***	-0.083829 (0.0026)***	-0.086511 (0.0039)***	-0.084677 (0.0010)***	-0.083307 (0.0032)***	-0.085236 (0.0025)***	-0.088154 (0.0001)***	-0.044485 (0.2740)	-0.050008 (0.2162)	-0.060892 (0.0487)
INV_ENERGY	9.01E-08 (0.2069)													
INV_GHG		3.15E-09 (0.6229)												
INV_WATER			2.40E-07 (0.0929)*											
COMMUNITY				516.5834 (0.1916)										
GB					-0.017114 (0.9091)									
HS						-0.017114 (0.9091)								
WOMEN							0.000610 (0.9006)							
GDS								-0.004945 (0.3864)						
SDS									-0.004709 (0.4122)					
EDS										0.002060 (0.5720)				
ESGDS											0.000559 (0.9272)			
BEP												-0.076854 (0.2030)		
BSPS													-0.012903 (0.7694)	
BGP														-0.093975 (0.1754)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
REIT dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Obs	1211	1206	909	558	1598	1598	1372	1649	1626	1626	1649	722	710	770
Periods	46	46	46	46	46	46	46	46	46	46	46	28	28	28
Crosssections	50	53	44	23	56	56	53	55	55	55	55	36	36	36
R2	0.613310	0.711656	0.633744	0.653693	0.594566	0.594566	0.599697	0.582490	0.584274	0.584181	0.581994	0.602158	0.608189	0.603362
Adj R2	0.591358	0.695215	0.606437	0.610318	0.577364	0.577364	0.579773	0.565346	0.566952	0.566855	0.565379	0.575046	0.581004	0.578126
Prob(F)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
DW	2.041997	1.901494	1.992706	2.035593	2.010201	2.010201	2.026402	1.997139	2.009512	2.010455	1.998303	2.009394	2.013138	2.016406
	Model 29	**Model 30**	**Model 31**	**Model 32**	**Model 33**	**Model 34**	**Model 35**	**Model 36**	**Model 37**	**Model 38**	**Model 39**	**Model 40**	**Model 41**	**Model 42**
Constant	-0.009309 (0.8475)	-0.027813 (0.5322)	-0.021418 (0.6267)	0.038724 (0.6124)	-0.039531 (0.3821)	-0.054179 (0.2306)	0.001368 (0.9770)	-0.054804 (0.2380)	-0.070947 (0.1486)	-0.090061 (0.0784)*	-0.086646 (0.0706)*	-0.144867 (0.1232)	-0.161649 (0.0995)*	-0.209018 (0.0163)**
Market Cap	0.002228 (0.2560)	0.003364 (0.0651)*	0.003188 (0.1113)	0.001649 (0.5758)	0.003322 (0.0509)*	0.004198 (0.0167)**	0.003527 (0.0757)*	0.005331 (0.0083)***	0.004628 (0.0107)**	0.005545 (0.0056)***	0.006077 (0.0054)***	0.008318 (0.0202)**	0.008322 (0.0330)**	0.013422 (0.0004)***
LTV	0.000770 (0.0002)***	0.000526 (0.0013)***	0.000515 (0.0040)***	0.000178 (0.5378)	0.000594 (0.0003)***	0.000621 (0.0002)***	0.000560 (0.0004)***	0.000730 (0.0000)***	0.000696 (0.0001)***	0.000716 (0.0000)***	0.000721 (0.0000)***	0.002010 (0.0000)***	0.002132 (0.0000)***	0.001909 (0.0000)***
ROE	-0.000259 (0.2485)	-3.56E-05 (0.8614)	-5.94E-05 (0.7835)	0.000255 (0.2931)	-0.000212 (0.3356)	-0.000169 (0.4293)	-0.000114 (0.5760	-0.000127 (0.4863)	-0.000197 (0.3688)	-0.000223 (0.3082)	-0.000176 (0.3251)	-0.000144 (0.7660)	-0.000184 (0.7136)	-3.68E-05 (0.9345)
REV Growth	-7.74E-05 (0.1883)	-4.12E-05 (0.4344)	-7.62E-05 (0.1710)	2.99E-05 (0.7299)	7.57E-06 (0.8676)	-2.63E-07 (0.9953)	1.83E-05 (0.7614)	-1.16E-05 (0.8219)	8.00E-06 (0.8686)	1.30E-06 (0.9783)	-1.03E-05 (0.8417)	6.49E-06 (0.9364)	1.33E-05 (0.8779)	-1.87E-05 (0.8101)
Dividend Yield	-0.003188 (0.0000)***	-0.002464 (0.0002)***	-0.002227 (0.0115)**	- 0.000975 (0.1330)	-0.003103 (0.0001)***	-0.003071 (0.0001)***	-0.002710 (0.0001)***	-0.003158 (0.0000)***	-0.003059 (0.0001)***	-0.003203 (0.0001)***	-0.003176 (0.0000)***	-0.004152 (0.0005)	-0.004393 (0.0004)***	-0.002934 (0.0016)***
INV_ENERGY	1.98E-09 (0.4213)													
INV_GHG		-5.14E-11 (0.8168)												
INV_WATER			1.35E-08 (0.0371)**											
COMMUNITY				- 4.425148 (0.3684)										
GB					-0.000553 (0.8435)									
HS						-0.006283 (0.2072)								
WOMEN							-0.000225 (0.0803)*							
GDS								-0.000446 (0.0048)***						
SDS									-0.000177 (0.3443)					
EDS										-0.000207 (0.0869)*				
ESGDS											-0.000448 (0.0572)*			
BEP												-0.003031 (0.2974)		
BSPS													-0.001516 (0.3780)	
BGP														-0.008594 (0.0024)***
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
REIT dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1215	1200	912	559	1611	1613	1380	1672	1643	1643	1672	733	720	781
Periods	46	46	46	46	46	46	46	46	46	46	46	28	28	28
CrossSections	50	53	44	23	55	55	52	54	54	54	54	35	35	37
R2	0.898890	0.632659	0.932248	0.947147	0.882962	0.883047	0.901140	0.882192	0.882073	0.882218	0.882023	0.884435	0.885218	0.887007
Adj R2	0.893170	0.611603	0.927214	0.940540	0.878038	0.878133	0.896249	0.877424	0.877212	0.877364	0.877401	0.876685	0.877373	0.879926
Prob(F)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
DW	1.864191	2.000345	1.976347	1.849276	2.003060	1.996333	1.979319	1.997353	1.996895	1.994988	1.995019	2.006150	2.007886	1.995359

Notes: “*”, “**” and “***” indicate statistical significance at the 10%, 5% and 1% level respectively.

Discussion

Increasingly, stakeholder consciousness considers that corporate purpose must contribute meaningfully to improving society as a whole. Consequently, there has been a meteoric rise in sustainable and ESG-oriented investing. Indeed, in recent years global sustainable investment has exhibited a tenfold increase since 2004, and up 68 percent since 2014 (McKinsey, 2023), driven by heightened social, governmental, and consumer awareness and increased scrutiny on the impact companies have on society. As a consequence, ESG criteria have emerged as essential components for measuring a company’s impact and progress toward achieving social goals in addition to creating shareholder value based on their environmental footprint, relationships with employees and the community where it operates.

In terms of investment and asset optimisation, discussions centre around whether ESG improves financial performance with well-executed ESG envisaged to strengthen investment returns by allocating capital to more promising and sustainable opportunities. In this regard, contemporary ESG programs are seen as integral components of business value creation and risk management strategies embedded within operating models driving a company’s reputation and market value. Nonetheless, despite the fact that ESG is increasingly dominating boardroom agendas, criticisms remain namely; that not all of its components have received adequate or equal attention, companies have struggled to put ESG pledges into practice with some institutional investors seen to treat ESG as a peripheral, rather than an integral part of their investment strategies and core activities.

Intuitively from the perspective of traditional economics and finance, ESG attributes should carry a price discount for most listed companies as they are the components of their corporate structure that do not contribute to revenue/profit generation, while the investment required to update operations according to an ESG strategy can be significant. Nonetheless, our statistical findings seem to falsify such proposition demonstrating there to be no statistical evidence that ESG attributes depress the performance of the listed real estate companies and at the very least, are in accordance with the line of comprehensive research which demonstrates no relationship between sustainable investment and reduced returns. In the main, our empirical evidence within the large majority of the panel data models either indicate a non-negative effect of ESG on the firms' financial performance proxied by raw return, Sharpe and Tobin's q, or produce statistically insignificant results with the Causality analysis exhibiting some ESG attributes to actually Granger-cause raw return, adjusted return and Tobin's q. For instance, we do not observe any statistically significant coefficients on the ESG attributes across all Sharpe models (i.e. Models 15-28). On the other hand, it can be inferred from the results that INV_WATER is positively associated with Tobin's q, indicating that reduced water consumption tends to result in enhanced corporate financial performance.

In relation to the governance disclosure score and Bloomberg governance pillar score, they are both found to be factors limiting Tobin's q (Models 36 and 42). One possible explanation, in line with Bauer et al. (2010) who showed that governance dimension is not related to returns performance and is a less important factor, is that there is a time lag between investment on governance and the realisation enhanced returns performance can take months, if not years, for companies to observe the effect of better corporate governance on financial performance. This is also in accordance with Hsieh et al. (2020) who showed differences in both short- and-long-term effects. Our analysis, as evidenced within the Pedroni Cointegration tests further reveal strong long-term interlinkages between the high majority of the ESG attributes and the three performance indicators, inferring that as listed real estate companies in Europe devote more resources to the development of ESG, their corporate finances tend to move in tandem. More specifically, each ESG attribute examined is at least cointegrated with one of the three performance indicators at the five percent level of statistical significance. This indeed provides a strong justification for more entrepreneurial effort to continue the growing initiative of ESG within the European listed real state sector.

Examination of the causal interrelationships between the time series provides additional insights into the short- and long-term dynamics between the ESG attributes and the financial performance indicators. It is indicative that each ESG attribute and the aggregate score exhibit varying levels of causal correlation with raw return, Sharpe and Tobin's q. For example, INV_ENERGY, INV_GHG and INV_WATER do not Granger-cause any of the financial performance indicators in the long-run, seemingly suggesting that the three ESG attributes have no causal influence on firm-level financial fundamentals. However, we find that the opposite Granger causation seem to hold for some of the performance attributes. For instance, an increased raw return may result in companies reducing their energy consumption symbolising that a reduction in energy use at corporate level could lead to better financial performance; a better performance on raw return, Sharpe and Tobin's q tend to be a "stimulant" for companies adopting more environmentally friendly policies in relation to greenhouse gas reduction and that continued growth in financial performance is likely to result in real estate firms adopting measures to reduce GHG emissions. In many instances reduction in water and power usage may not require significant expenditure, just better asset and facilities management and given that these utilities are a component of the cost base to the business, a neutral or positive effect is not unreasonable.

We surmise that as the sample listed real estate companies grow financially, they should be in a more favourable financial position to implement more ESG programmes in a way that resonates the considerations amongst key stakeholders, investors and the community of social management and environmental professionals. Further, it is evident that there is a bi-directional causal relationship between the percentage of women in the workforce (WOMAN) and raw return in both the short- and long-term. This suggests that the listed real estate companies across Europe seem to consider gender diversity as a positive attribute as they grow over time, which manifests itself through a positive feedback loop that drives their financial performance further. Furthermore, it seems logical that hiring / promoting the best candidate for a position, without a gender bias, should at minimum have neutral impact on firm performance and in all probability would increase performance, regardless of diversity considerations.

The results on the three aggregate Bloomberg ESG performance scores provide a different picture than those of the individual ESG attributes. Based on the results of the Granger Causality models, we find that BEP, BSPS and BGP all Granger-cause raw return and Sharpe in the long-run. Put differently, a higher score on the environmental, social and governance performance of the companies should lead to a superior return on both the raw and risk-adjusted basis. We conjecture that such a superior return performance could be a direct consequence of investors, particularly multinationals and sovereign investment funds, placing more emphasis on ESG when formulating their investment strategies, particularly in recent years. Pertinently, Europe has seen an increasing appetite within the real estate sector for more environmentally sustainable and socially responsible investment projects, a result of concerted effort from the governments and the business community. For the social performance score, we further observe that it is Granger-caused by Sharpe and Tobin's q, implying that the sample companies would become even more "socially responsible" for their investments and operations after they have achieved stronger financial performance. On the whole, our results suggest that when determining whether a company can be benefited financially in the long run by the adoption of more ESG measures and practices at the firm level, one should take a more holistic view by considering the aggregate ESG scores instead of their individual counterparts.

Research, notably within the REIT sector, has increasingly focussed on the role of ESG disclosure. Similar to existing studies (Chiang et al., 2017; Feng and Wu, 2021; Yu, Guo, and Luu, 2018) who demonstrated that disclosure has a positive association with the cost of capital, firm value, the empirical findings within this study in relation to information disclosure, identifies that transparency about the state of ESG of a company seems to be a performance driver for the sample listed companies as the results of Causality tests suggest: EDS, SDS, GDS and ESGDS all Granger-cause raw return and Sharpe in the long-run at the conventional level of statistical significance. Indeed, it is further evident that EDS and GDS lead the time series of Tobin's q. We posit from an information symmetry standpoint that, other things being equal, listed real estate investors are more willing to pay a premium for a higher degree of transparency in relation to ESG adoption and performance. In other words, firms tend to gain from building reputation for more transparent ESG reporting, which should result in enhanced management credibility, a higher PE ratio, increased liquidity and/or a reduced cost of capital in the long-term. Last but not least, EDS, GDS and ESGDS display a two-way Granger causation with raw return, Sharpe and/or Tobin's q, providing robust evidence that as the financial performance improve, companies are more inclined to report their ESG information to shareholders and other stakeholders. This indeed is a clear indication of a growing maturity with respect to ESG reporting and practices within the listed real estate sector in the UK and Europe.

Conclusions

This research has presented the results of a novel investigation into firm level ESG attributes and their relationship to firm performance over a notable time period relevant to the business planning cycle of Listed Real Estate in Europe. The research curates a broad array of indicators, including both established industry indicators and a number of bespoke indicators derived from close examination and interrogation of publicly available company accounts. Together, these indicators provide a solid basis for appraising the ESG performance of the listed sector. The research relates this performance to financial performance to assess levels of correlation and causation, to provide insight into the extent to which a focus on ESG promotes or detracts from financial performance, or indeed the direction of any such relationship.

The results of the research have given some deep insights into these interrelationships, which are of great interest to both academics in the area and to industry practitioners. It is apparent that whilst a focus on (or more correctly, good performance) ESG does not adversely affect financial performance. Given the perceived financial restrictions of pursuing such altruistic strategies, this is a considerable finding. It does appear that there are no immediate financial benefits from ESG focus either, despite the increasing focus on this agenda, the relatively transparent nature of the sector and its liquidity. Perhaps it could be viewed in terms of ESG performance preventing certain investor groups from disinvesting, thereby maintaining a status quo.

It can be seen that improved financial performance does drive improved ESG performance. This is interesting from the perspective of the perceived cost of ESG intimated earlier – strong financial performance providing the financial 'headroom' to justify the ESG improvements that the market increasingly requires to comply with their growing ESG mandates. This does appear to have elements of a potential 'virtuous cycle' – if the sector perceives that earlier expenditure and focus on ESG will not hamper performance, facilitating earlier and deeper focus, with subsequent financial success reinvested in ESG. The research also carries a wider policy significance. In setting broad ESG policy objectives and more specific performance targets via legislation, government at all levels is naturally cognizant of the economic and financial implications to the affected sector. Perhaps even more significance is placed on not differentially impacting competitiveness relative to other regions, which may drive capital outflows beyond the jurisdiction or to alternative sectors which may have unintended consequences (such as starving the carbon intensive real estate sector of the capital necessary to improve performance). These concerns necessarily act to dilute the strength of ESG policy and delay its introduction. The clear message emanating from this research is that policy makers can have more confidence in developing and rolling out ESG policy, without excessive concern of its potential adverse effects. Early adopters can be identified and supported to go further, earlier, whilst those exhibiting reluctance can be targeted for support where useful and enforcement where appropriate. Such policy initiatives can be bolstered against likely negative feedback with an evidence base that supports the notion that ESG activities are on the whole benign in the short-term and potentially beneficial in the medium- to long-term from both investor appeal and compliance perspectives, providing evidential impetus for initiating and mainstreaming ESG as part of corporate policy.

The implications of our research are therefore (i) real estate firms should not be afraid of ESG being a negative performance attribute, (ii) governments around the world, particularly in Europe, should promote ESG in the listed real estate sector (consistent with previous research studies), (iii) the commonly observed negative effects of ESG may be just short-lived, it could take a few years for the ESG-induced growth to be realised. Lastly, it does appear that ESG is beginning to 'come of age', as not only a cost centre, but increasingly an added value element to the business strategy within European Listed Real Estate, capable of sustaining itself and potentially providing a cutting edge in the highly competitive sector.

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Appendices

Results of Causality Tests (Raw Return)

	LAG=1			LAG=2		
	Short Term Chi-sq (Prob)	Long Term EC t-stat (Prob)	Y_{t-1} (p-value) X_{t-1} (p-value)	Short Term Chi-sq (Prob)	Long Term EC t-stat (Prob)	Y_{t-1} (p-value) Y_{t-2} (p-value) X_{t-1} (p-value) X_{t-2} (p-value)
INV_ENERGY ->RAW	0.159608 (0.6895)	-0.175968 -2.484159 (0.0133)***	-0.141670 (0.0232)** -5.04E-07 (0.6897)	2.111538 (0.3479)	-0.183877 -2.397258 (0.0169)**	-0.139080 (0.0706)* 0.013888 (0.7991) -4.27E-07 (0.7412) 1.01E-06 0.1603)
RAW → INV_ENERGY	0.755230 (0.3848)	-1728.915 -0.951675 (0.3417)	566.7120 (0.3852) 0.031674 (0.2284)	1.082460 (0.5820)	-2101.462 -1.109245 (0.2679)	863.9150 (0.3021) 341.7919 (0.4602) 0.029162 (0.2482) 0.054867 (0.0055)***
INV_GHG → RAW	0.441814 (0.5062)	0.114831 0.976599 (0.3314)	-1.173184 (0.0000)*** 191708.2 (0.5079)	1.652692 (0.4376)	0.185777 0.967369 (0.3366)	-1.448682 (0.0007) -0.227501 (0.4756) 176334.0 (0.5146) 523574.0

						(0.2753)
RAW→ INV_GHG	7.706476 (0.0055)***	-1.55E-07 -6.934730 (0.0000)***	1.17E-07 (0.0067)*** -0.260066 (0.0275)**	20.63525 (0.0000)***	-1.89E-07 -5.380568 (0.0000)***	1.56E-07 (0.0449)** 1.80E-08 (0.7682) -0.279546 (0.0075)*** -0.275844 (0.0554)*
INV_WATER→ RAW	0.003393 (0.9536)	29.27774 0.061249 (0.9513)	-12.00287 (0.9474) -584404.6 (0.9537)	0.004024 (0.9494)	-0.000225 -0.062873 (0.9500)	8.64E-05 (0.9495) 4.360441 (0.9539)
RAW→ INV_WATER	10.36109 (0.0056)***	-0.189025 -0.342349 (0.7330)	-1.036347 (0.0606)* -0.321255 (0.4932) 84231.33 (0.0154)** -19724.53 (0.2311)	0.792295 (0.6729)	-2.24E-06 -0.315208 (0.7534)	2.21E-06 (0.7559) 1.26E-06 (0.8303) -0.609850 (0.1328) 0.189293 (0.3671)
COMMUNITY→RAW	0.038455 (0.8445)	-1.860977 -0.293627 (0.7699)	-0.174172 (0.8657) 126478.4 (0.8451)	0.005502 (0.9409)	8.59E-06 0.266162 (0.7909)	6.58E-07 (0.9411) -1.447105 (0.7230)
RAW → COMMUNITY	1.032166 (0.5969)	-0.132457 -0.100894 (0.9199)	-0.420973 (0.4019) 0.161615 (0.5433) 9247.006 (0.6137) -41047.09 (0.4117)	0.791266 (0.6733)	-1.38E-05 -0.645218 (0.5211)	6.85E-06 (0.3777) 2.22E-06 (0.4939) -0.094607 (0.6714) 0.427021 (0.5711)
WOMEN→ RAW	0.002645 (0.9590)	-0.760414 -3.193043 (0.0016)***	-0.447038 (0.0000)*** 0.037119 (0.9590)	2.205551 (0.1375)	-0.122558 -1.670018 (0.0964)*	0.046350 (0.1391) 0.110610 (0.6054)
RAW→ WOMEN	11.23422 (0.0036)***	-0.552027 -2.616853 (0.0097)***	-0.902379 (0.0100)** -0.529126 (0.2884) 0.361615 (0.5849)	7.973550 (0.0186)**	-0.115230 -2.856003 (0.0048)***	0.140693 (0.0091)*** 0.137030 (0.0380)** -0.029022 (0.8418) 0.102005 (0.4050)
GDS→ RAW	0.098342 (0.7538)	-0.621631 -5.803759 (0.0000)***	-0.316975 (0.0016)*** 0.087376 (0.7540)	0.199515 (0.6551)	-0.064142 -2.730747 (0.0067)***	-0.007964 (0.6554) -0.091386 (0.3350)
RAW→ GDS	1.295862 (0.5231)	-0.591314 -5.116350 (0.0000)***	-0.457936 (0.0000)*** 0.087951 (0.2104) 0.085541 (0.7386) -0.367222 (0.2994)	3.820137 (0.1481)	-0.111252 -3.061172 (0.0024)***	0.039012 (0.1895) -0.006608 (0.7278) -0.058833 (0.5501) -0.091822 (0.3297)
EDS→ RAW	1.474749 (0.2246)	-0.810784 -7.362332 (0.0000)***	-0.292986 (0.0017)*** 0.328310 (0.2258)	0.009005 (0.9244)	-0.071904 -3.378323 (0.0009)***	-0.001589 (0.9245) 0.009943 (0.8637)
RAW→ EDS	2.384275 (0.3036)	-0.753983 -5.411575 (0.0000)***	-0.379001 (0.0011)*** 0.124715 (0.0736)* 0.336802 (0.1725) 0.181392 (0.4261)	0.302123 (0.8598)	-0.092890 -2.476179 (0.0141)**	-0.001237 (0.9691) -0.037008 (0.1191) -0.075340 (0.2857) -0.034158 (0.6681)
SDS→ RAW	0.005101 (0.9431)	-0.844013 -7.143310 (0.0000)***	-0.272711 (0.0048)*** 0.024062 (0.9431)	0.716298 (0.3974)	-0.013510 -0.810640 (0.4184)	-0.011630 (0.3982) 0.030234 (0.6054)
RAW→SDS	0.455570 (0.7963)	-0.732490 -5.080194 (0.0000)***	-0.349777 (0.0098)*** 0.145074 (0.0649)*	5.542088 (0.0626)*	-0.019681 -1.085240 (0.2791)	-0.018103 (0.3586) -0.027503 (0.0502)***

			0.158486 (0.6831) 0.214135 (0.5692)			-0.008549 (0.8971) -0.051815 (0.3650)
ESGDS→ RAW	7.64E-05 (0.9930)	-0.687401 -6.463089 (0.0000)***	-0.314610 (0.0007)*** -0.003632 0.9930	0.025351 (0.8735)	-0.030880 -3.336623 (0.0010)***	-0.001308 (0.8736) -0.001750 (0.9739)
RAW→ ESGDS	1.674992 (0.4328)	-0.577027 -5.293116 (0.0000)***	-0.457580 (0.0000) 0.094020 (0.2098) 0.377897 (0.3909) -0.437837 (0.3298)	12.18968 (0.0023)***	-0.038154 -3.023617 (0.0027)***	-0.003046 (0.8325) -0.023098 (0.0290)** -0.093936 (0.1277) -0.007016 (0.9049)
BEP→RAW	0.084264 (0.7716)	-0.358917 -11.22485 (0.0000)***	-0.010640 (0.7726) -1.372975 (0.7717)	10.21076 (0.0014)***	0.000264 1.863279 (0.0628)*	-0.000532 (0.0014)*** 0.784867 (0.0000)***
RAW→BEP	2.013752 (0.3654)	-0.639575 -4.171202 (0.0000)***	0.332152 (0.0888)* 0.701917 (0.0623)* 116.9472 (0.1670) -135.8960 (0.1764)	8.294440 (0.0158)**	0.000300 1.856915 (0.0637)*	-0.000547 (0.0042)*** -0.000150 (0.3968) 0.856928 (0.0000)*** -0.110527 (0.0018)***
BSPS→RAW	0.033023 (0.8558)	20.74124 0.180711 (0.8566)	-65.09520 (0.8543) 125.0299 (0.8558)	0.120396 (0.7286)	-0.005250 -0.373527 (0.7089)	0.014655 (0.7287) 0.695200 (0.0000)***
RAW→BSPS	0.505697 (0.7766)	-2.953609 -4.089036 (0.0000)***	2.792506 (0.0004)*** 7.986904 (0.0001)*** 9.609647 (0.6962) -24.66404 (0.3235)	0.140997 (0.9319)	-0.000477 -0.443271 (0.6577)	-5.28E-05 (0.9641) 0.000260 (0.9329) 0.815592 (0.0000)*** -0.161642 (0.0000)***
BGP→RAW	0.668552 (0.4136)	-0.366234 -11.82677 (0.0000)***	-0.017212 (0.6261) -4.206637 (0.4138)	0.064286 (0.7998)	-9.10E-05 -0.714711 (0.4750)	-3.76E-05 (0.7999) 0.755070 (0.0000)***
RAW→BGP	0.848081 (0.6544)	-0.445499 -13.12650 (0.0000)***	0.058981 (0.1268) 0.200279 (0.0000)*** -5.439489 (0.5051) 0.760807 (0.9243)	1.565389 (0.4572)	1.59E-05 0.112985 (0.9101)	-0.000141 (0.3919) -0.000177 (0.2458) 0.844527 (0.0000)*** -0.127072 (0.0001)***

Results of Causality Tests (Sharpe)

	LAG=1			LAG=2		
	Short Term Chi-sq (Prob)	Long Term EC t-stat (Prob)	Y_{t-1} (p-value) X_{t-1} (p-value)	Short Term Chi-sq (Prob)	Long Term EC t-stat (Prob)	Y_{t-1} (p-value) Y_{t-2} (p-value) X_{t-1} (p-value) X_{t-2} (p-value)
INV_ENERGY-> SHARPE	0.291595 (0.5892)	-0.214602 -2.887984 (0.0040)***	-0.119784 (0.0119)** -9.67E-08 (0.5894)	5.997701 (0.0498)**	-0.167261 -2.359629 (0.0187)**	-0.170237 (0.0015)*** -0.128101 (0.0032)*** -7.38E-08 (0.6567) 3.70E-07 (0.0164)**
SHARPE → INV_ENERGY	0.698377 (0.4033)	-12988.49 -0.973613 (0.3307)	3604.883 (0.4037) 0.029123 (0.2337)	1.091923 (0.5793)	-14061.06 -1.106906 (0.2689)	5897.960 (0.3358) 1842.709 (0.5258) 0.027576 (0.2539) 0.053338

						(0.0099)***
INV_GHG→ Sharpe	0.190061 (0.6629)	0.450492 1.773356 (0.0795)*	-1.258663 (0.0000)*** 36172.65 (0.6639)	0.716032 (0.6991)	1.081337 0.887190 (0.3779)	-2.426434 (0.1644) -1.014832 (0.3290) 122546.5 (0.4108) 68253.72 (0.7050)
Sharpe → INV_GHG	6.716515 (0.0096)***	-1.28E-06 -5.061134 (0.0000)***	9.35E-07 (0.0111)** -0.265895 (0.0410)**	6.557731 (0.0377)**	-2.10E-06 -2.388479 (0.0195)**	1.88E-06 (0.1935) 6.99E-07 (0.4152) -0.362982 (0.0140)** -0.277245 (0.0569)*
INV_WATER→ Sharpe	0.803119 (0.3702)	0.494677 0.595007 (0.5532)	-0.904715 (0.0317)** -4916.713 (0.3723)	1.288790 (0.2563)	-6.14E-05 -1.102804 (0.2728)	2.86E-05 (0.2590) -0.047886 (0.9186)
Sharpe → INV_WATER	5.109815 (0.0777)*	0.168537 0.138888 (0.8899)	-0.990496 (0.2760) -0.435856 (0.5173) 746.5540 (0.8859)	0.309812 (0.8565)	-2.12E-05 -0.249954 (0.8032)	1.52E-05 (0.8115) 9.76E-06 (0.8408) -0.610374 (0.1542) 0.215581 (0.4202)
COMMUNITY→ Sharpe	0.003478 (0.9530)	5.629944 0.054127 (0.9570)	-1.010122 (0.9439) -32134.58 (0.9531)	0.005599 (0.9404)	0.000332 0.098838 (0.9215)	-4.12E-05 (0.9406) -2.415939 (0.9167)
Sharpe → COMMUNITY	0.049226 (0.9757)	2.110547 0.130794 (0.8963)	-0.711478 (0.8692) -0.093516 (0.9661) 2959.071 (0.8604) -6824.218 (0.8292)	0.016157 (0.9920)	-0.000633 -0.104947 (0.9168)	0.000176 (0.9112) 6.93E-05 (0.9182) -0.265547 (0.9143) 1.164676 (0.9082)
WOMEN → Sharpe	2.02E-09 (0.972148)	NA	-0.331712 (0.0242) -3.25E-06 (0.9900)	1.660171 (0.1976)	NA	0.432069 (0.1990) 0.120283 (0.6201)
Sharpe→ WOMEN	7.121770 (0.0284)**	NA	-0.703228 (0.0006)*** -0.279463 (0.3505) 0.022464 (0.7901) -0.164849 (0.0639)*	4.184237 (0.1234)	NA	0.700582 (0.0546)* 0.815761 (0.0712)* 0.023207 (0.8930) 0.130122 (0.4274)
GDS→ Sharpe	0.502496 (0.4784)	-0.549211 -5.529566 (0.0000)***	-0.242658 (0.0227)** 0.025055 (0.4790)	0.120474 (0.7285)	-0.592242 -3.227532 (0.0014)***	0.047532 (0.7288) -0.070899 (0.4149)
Sharpe → GDS	2.633936 (0.2679)	-0.613815 -5.537179 (0.0000)***	-0.198727 (0.1420) 0.237399 (0.0140)** 0.039150 (0.2206) -0.031960 (0.3983)	5.775316 (0.0557)*	-0.929966 -3.594072 (0.0004)***	0.324798 (0.0595)* -0.073107 (0.6325) -0.038413 (0.6518) -0.067176 (0.4428)
EDS→ Sharpe	0.027489 (0.8683)	-0.678389 -6.317130 (0.0000)***	-0.229841 (0.0232)** 0.005578 (0.8685)	0.094042 (0.7591)	-0.470843 -3.222755 (0.0014)***	0.038637 (0.7594) 0.035186 (0.5623)
Sharpe → EDS	0.302123 (0.8598)	-0.798929 -5.132532 (0.0000)***	-0.133154 (0.3668) 0.244284 (0.0129)** 0.005544 (0.8581) 0.018490 (0.58700)	0.249739 (0.8826)	-0.690165 -2.454671 (0.0149)**	0.044514 (0.8608) -0.038799 (0.8324) -0.056288 (0.4111) -0.057719 (0.4727)

SDS→ Sharpe	0.062754 (0.8022)	-0.805787 -7.464898 (0.0000)***	-0.171310 (0.0928)* 0.010574 (0.8024)	2.455700 (0.1171)	-0.037319 -0.291200 (0.7712)	-0.181140 (0.1184) 0.028068 (0.6330)
Sharpe →SDS	0.041618 (0.9794)	-0.856429 -6.371757 (0.0000)***	-0.089619 (0.5452) 0.250103 (0.0156)** 0.008695 (0.8386) -0.000294 (0.9953)	1.794110 (0.4078)	-0.152233 -1.021238 (0.3083)	-0.149543 (0.3019) -0.150352 (0.1844) -0.004968 (0.9436) -0.056351 (0.3140)
ESGDS→ Sharpe	0.232496 (0.6297)	-0.605922 -6.497926 (0.0000)***	-0.253098 (0.0075)*** -0.027493 (0.6300)	0.465907 (0.4949)	-0.198614 -2.666058 (0.0081)***	-0.052366 (0.4954) 0.009265 (0.8664)
Sharpe → ESGDS	1.411305 (0.4938)	-0.723635 -6.304283 (0.0000)***	-0.170227 (0.1883) 0.231299 (0.0092)*** -0.001789 (0.9718) -0.069842 (0.2362)	2.879706 (0.2370)	-0.366873 -3.229579 (0.0014)***	0.045280 (0.6812) -0.085380 (0.3504) -0.078675 (0.2238) -0.008977 (0.8817)
BEP→Sharpe	2.030696 (0.1542)	-0.426821 -13.01146 (0.0000)***	-0.129574 (0.0001)*** -0.696393 (0.1545)	8.545196 (0.0035)***	0.003632 1.877952 (0.0607)*	-0.006690 (0.0036)*** 0.778304 (0.0000)***
Sharpe →BEP	3.213457 (0.2005)	-0.443229 -12.20878 (0.0000)***	-0.127953 (0.0011)*** -0.016922 (0.6183) -1.131752 (0.1667) 0.305604 (0.7055)	0.387070 (0.8240)	0.003204 2.013297 (0.0444)**	-0.000959 (0.5802) 1.91E-05 (0.9898) 0.866809 (0.0000)*** -0.120826 (0.0007)***
BSPS→ Sharpe	0.073785 (0.7859)	-0.375988 -12.20743 (0.0000)***	-0.147060 (0.0000)*** 0.064785 (0.7860)	2.732108 (0.0983)*	-0.006276 -2.052933 (0.0404)**	-0.005453 (0.0987)* 0.717011 (0.0000)***
Sharpe →BSPS	0.001613 (0.9992)	-0.390577 -11.42606 (0.0000)***	-0.146861 (0.0001)*** -0.028090 (0.4139) 0.007517 (0.9833) 0.003082 (0.9930)	3.935273 (0.1398)	-0.003981 -1.180375 (0.2382)	-0.007635 (0.0482)** -0.002300 (0.4970) 0.820833 (0.0000)*** -0.160533 (0.0000)***
BGP→ Sharpe	1.909837 (0.1670)	-0.402919 -13.11587 (0.0000)***	-0.141094 (0.0000)*** -0.732620 (0.1673)	0.204118 (0.6514)	-0.000329 -0.269128 (0.7879)	-0.000575 (0.6515) 0.765853 (0.0000)***
Sharpe →BGP	4.230851 (0.1206)	-0.423620 -12.50371 (0.0000)***	-0.136827 (0.0002)*** -0.019952 (0.5412) -1.650487 (0.0542)* 0.860472 (0.3085)	0.235584 (0.8889)	-0.000179 -0.132057 (0.8950)	-0.000587 (0.6959) -0.000557 (0.6701) 0.850028 (0.0000)*** -0.128291 (0.0002)***

Results of Causality Tests (Tobin's q)

	LAG=1			LAG=2		
	Short Term Chi-sq (Prob)	Long Term EC t-stat (Prob)	Y_{t-1} (p-value) X_{t-1} (p-value)	Short Term Chi-sq (Prob)	Long Term EC t-stat (Prob)	Y_{t-1} (p-value) Y_{t-2} (p-value) X_{t-1} (p-value) X_{t-2} (p-value)
INV_ENERGY-> Tobin's q	6.212242 (0.0127)**	-0.072832 -1.435531	0.040871 (0.7782)	0.143490 (0.9308)	-1.284865 -0.173097	0.387522 (0.8687)

		(0.1519)	-1.90E-08 (0.0131)**		(0.8627)	-0.223717 (0.6690) -1.53E-07 (0.8450) -1.07E-07 (0.8704)
Tobin's q→ INV_ENERGY	10.17269 (0.0062)***	-156230.4 -0.522229 (0.6018)	-8799.759 (0.9380) 0.995479 (0.3201)	0.045747 (0.9774)	-3949683 -0.203049 (0.8392)	1108237 (0.8553) -244796.5 (0.8846) -0.394633 (0.8474) -0.301660 (0.8617)
INV_GHG→ Tobin's q	0.215028 (0.6429)	0.011038 0.544512 (0.5877)	-0.499185 (0.0007)*** -587.7258 (0.6442)	0.951375 (0.6215)	0.006289 0.147150 (0.8835)	-0.528741 (0.0086)*** 0.260597 (0.1144) -550.9784 (0.7235) -1719.584 (0.3861)
Tobin's q → INV_GHG	3.697634 (0.0545)*	-6.31E-06 -5.370516 (0.0000)***	1.32E-05 (0.0584)* -0.168425 (0.0224)**	5.677739 (0.0585)*	-6.88E-06 -4.473805 (0.0000)***	9.72E-06 (0.1460) -7.44E-06 (0.0832)* -0.200247 (0.0039)*** 0.018809 (0.7806)
INV_WATER→ Tobin's q	0.130279 (0.7181)	-0.036820 -1.284635 (0.2038)	-0.308995 (0.0078)*** 23.78265 (0.7194)	0.965064 (0.3259)	-0.000125 -1.139579 (0.2588)	0.000170 (0.3297) -0.222553 (0.4292)
Tobin's q → INV_WATER	0.188807 (0.9099)	-0.127305 -1.085386 (0.2832)	-0.127203 (0.5322) 0.524539 (0.0275)** 9.475637 (0.9073) 27.01930 (0.6731)	0.103098 (0.9498)	-0.000129 -0.298923 (0.7662)	0.000205 (0.7640) 0.000231 (0.7501) -0.625694 (0.0994)* 0.172613 (0.3251)
COMMUNITY→ Tobin's q	0.000705 (0.9788)	NA	1.526307 (0.9836) -5983.483 (0.9789)	2.159908 (0.1417)	NA	0.000466 (0.1465) -0.466249 (0.6236)
Tobin's q → COMMUNITY	0.303190 (0.8593)		0.107217 (0.8829) 0.273350 (0.5729) -231.0946 (0.6605) -200.0032 (0.5899)	0.012126 (0.9940)	NA	-0.000371 (0.9639) 0.000130 (0.9314) 0.666702 (0.9313) 0.634796 (0.8556)
WOMEN → Tobin's q	1.753625 (0.1854)	-0.026219 -1.250645 (0.2128)	-0.376551 (0.0000)*** 0.002470 (0.1872)	0.154404 (0.6944)	-3.077692 -3.422602 (0.0008)***	-1.686665 (0.6949) -0.054328 (0.6914)
Tobin's q → WOMEN	6.412950 (0.0405)**	-0.029450 -1.173069 (0.2428)	-0.329185 (0.0031)*** 0.166007 (0.1980) 0.004077 (0.0168)** 7.61E-05 (0.9643)	0.889875 (0.6409)	-3.651737 -3.452366 (0.0007)***	-3.997765 (0.4724) -5.178158 (0.4115) -0.064384 (0.6359) -0.020274 (0.8139)
GDS→ Tobin's q	0.247299 (0.6190)	-0.059567 -0.709786 (0.4785)	0.375512 (0.7165) -0.001405 (0.6194)	0.910335 (0.3400)	-1.570306 -5.871223 (0.0000)***	3.349089 (0.3410) -0.028067 (0.6364)
Tobin's q → GDS	2.292112 (0.3179)	-0.085432 -1.884805 (0.0608)*	0.007376 (0.9747) 0.416597 (0.0731)* -0.002215 (0.1774) -0.001308 (0.5344)	0.429994 (0.8065)	-1.518503 -0.828105 (0.4085)	-5.090238 (0.6015) -6.610186 (0.5286) 0.026139 (0.7797) -0.065052 (0.5626)

EDS→ Tobin's q	0.386234 (0.5343)	-0.163295 -1.556217 (0.1214)	-0.066457 (0.7280) 0.001662 (0.5351)	5.284202 (0.0215)**	-2.274341 -0.573871 (0.5668)	-18.27906 (0.0227)** 0.000844 (0.9940)
Tobin's q → EDS	4.684653 (0.0961)*	-0.167139 -2.117371 (0.0358)**	-0.094524 (0.4790) 0.243604 (0.0593)* 0.001637 (0.3962) 0.004169 (0.0324)**	8.597955 (0.0136)**	-2.992511 -0.792419 (0.4293)	-17.28991 (0.0191)** -1.827051 (0.8018) -0.043023 (0.6940) -0.018021 (0.8688)
SDS→ Tobin's q	1.111172 (0.2918)	-0.123460 -1.040677 (0.2994)	0.031704 (0.9253) 0.007813 (0.2933)	0.040319 (0.8409)	-2.936151 -0.910020 (0.3640)	-1.934562 (0.8411) 0.186800 (0.3758)
Tobin's q →SDS	0.949110 (0.6222)	-0.096051 -0.904385 (0.3672)	-0.084779 (0.7829) 0.275231 (0.2976) 0.012473 (0.3787) 0.010590 (0.3315)	0.624945 (0.7316)	-2.379859 -1.053748 (0.2936)	-3.653112 (0.5770) 1.057152 (0.8156) 0.276972 (0.3691) 0.206988 (0.4109)
ESGDS→ Tobin's q	0.075585 (0.7834)	-0.139244 -0.645529 (0.5192)	0.355375 (0.7228) 0.002387 (0.7836)	0.700951 (0.4025)	-0.366202 -0.171080 (0.8643)	-8.316165 (0.4033) -0.004656 (0.9626)
Tobin's q→ ESGDS	0.322650 (0.8510)	-0.135962 -1.106428 (0.2698)	0.098668 (0.7948) 0.443270 (0.2238) 0.002852 (0.6669) 0.001309 (0.7808)	3.473410 (0.1761)	-0.939692 -0.657763 (0.5114)	-6.770210 (0.1637) -1.930816 (0.7125) -0.068340 (0.4868) -0.013692 (0.8225)
BEP→Tobin's q	0.529577 (0.4668)	-0.004755 -0.979411 (0.3277)	-0.280811 (0.0000)*** 0.012123 (0.4670)	0.913041 (0.3393)	-0.023259 -3.592449 (0.0004)***	-0.045042 (0.3396) 0.785567 (0.0000)***
Tobin's q →BEP	4.990671 (0.0825)*	-0.005393 -0.812419 (0.4168)	-0.303030 (0.0000)*** -0.005944 (0.8747) 0.061914 (0.0293)** -0.056471 (0.0451)**	0.345154 (0.8415)	-0.024864 -2.805583 (0.0052)***	-0.023368 (0.6453) 0.010443 (0.8356) 0.847539 (0.0000)*** -0.098927 (0.0084)
BSPS→ Tobin's q	0.621932 (0.4303)	0.001099 0.276962 (0.7819)	-0.286437 (0.0000)*** 0.006585 (0.4306)	4.11E-05 (0.9949)	-0.063739 -5.509363 (0.0000)***	0.000669 (0.9949) 0.729815 (0.0000)***
Tobin's q →BSPS	1.370664 (0.5039)	0.002635 0.656493 (0.5117)	-0.315647 (0.0000)*** -0.012018 (0.7524) 0.014939 (0.2486) -0.009266 (0.4699)	0.348792 (0.8400)	-0.056903 -4.842492 (0.0000)***	0.001554 (0.9890) -0.062427 (0.5770) 0.807709 (0.0000)*** -0.128625 (0.0006)***
BGP→ Tobin's q	0.556265 (0.4558)	-0.003126 -0.469479 (0.6389)	-0.272769 (0.0000)*** -0.014054 (0.4560)	0.600158 (0.4385)	0.027180 3.396827 (0.0007)***	-0.032198 (0.4388) 0.764537 (0.0000)***
Tobin's q →BGP	0.034889 (0.9827)	-0.121644 -0.168923 (0.8659)	-0.084571 (0.9503) 0.133757 (0.8833) 5.728942 (0.8711) -5.678240 (0.8707)	0.009513 (0.9953)	0.000389 0.001900 (0.9985)	0.012546 (0.9743) 0.015592 (0.9533) 2.214262 (0.8202) -1.477650 (0.8781)

Notes: "*", "**" and "***" indicate statistical significance at the 10%, 5% and 1% level respectively. We present the Chi-square and the corresponding probability for the Wald test on the coefficient restriction, the coefficient on the error correction term alongside its corresponding t-statistics and probability, as well as the coefficients on the lagged terms for the long-term causality.

The 95% confidence interval is used to determine the statistical significance of the variables across two time lag intervals, *t*-1 and *t*-2.