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# How Does ESG Performance Affect Firm Values and Overinvestments?*

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Abstract

Examining the relationship between environmental, social, and governance (ESG) performance and firm value has attracted significant attention, as ESG investing has grown rapidly over the last decade. In this study, we examine this issue by investigating the structural change in the effects of ESG scores and firm value, as proxied by Tobin's Q. The results indicate that ESG scores have a more positive impact on Tobin's Q only after 2011, and social and controversial pillars are the most significant in explaining firm valuation. Concerning firm investment, our results also suggest that firms with better ESG have more investment opportunities through higher Tobin's Q. Given these results, this study also investigates whether firms with higher ESG performance have a higher tendency to overinvest. The overall results suggest that although ESG performance has significant positive effects on the firms' opportunity to invest after 2011, this does not necessarily imply that firms with higher ESG performance have a higher tendency to overinvest.

Keywords: Environmental, Social, Governance, Controversies, Tobin's Q, Overinvestment
JEL classification: D25, G30, G32



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# 1 Introduction

Over the last decade, there has been an increasing interest in environmental, social, and governance (ESG) investing, which refers to a class of investing also known as "sustainable investing." Consequently, the level of ESG investment has grown significantly over the past 10 years. For example, the total assets under management in ESG investing reached more than 100 trillion US dollars in 2020, increasing nearly five times since 2010. In addition, the number of signatories of the UN Principles of Responsible Investment (PRI) has exceeded 3000 signatories among institutional investors, more than quadrupling over the last decade. This is clear evidence that many asset owners are looking to increase investments that have a positive social and environmental impact to pursue long-term investment performance.

One natural question related to ESG investment is whether investing in high-ESG-characteristic firms improves overall portfolio performance. Similarly, it is considerably instructive to examine whether a higher ESG performance leads to higher firm values. As will be reviewed in the next section, many recent studies document a positive relationship between ESG performance and firm value. The first objective of this study is to provide additional empirical evidence on this issue. Specifically, this study examines how ESG scores affect firm values as assessed by Tobin's $Q$. We also investigate whether ESG scores have a greater impact on firm values in recent years, given the rapid development of ESG investments over the last decade. Furthermore, we examine which ESG pillar(s) have more effects on firm value.

Concerning firm investment, higher firm values, as represented by high Tobin's $Q$, could provide firms larger investment opportunities. Therefore, it could be inferred that firms with better ESG performance could have more investment opportunities if higher ESG scores are associated with higher firm values. Nevertheless, in economics, the logic of optimality always prevails. If firms with higher ESG performance have greater investment opportunities, does that mean they have a higher tendency to overinvest? If yes, which ESG pillar(s) can explain their overinvestment? We also attempt to empirically find answers to these questions.

This study contributes to the current strand of literature in three ways. The first is related to ESG scores and firm values. Many previous studies have documented a positive relationship between ESG scores and firm values. This study sheds light on additional aspects of this literature by examining whether ESG scores have more impact on firm values in recent years and which ESG pillar(s) have more effects on firm value. The second is about the relationship between ESG and firms' financial decision-making. Many studies have focused on how ESG performance affects firm valuation. Nonetheless, few studies discuss the financial decision-making characteristic of firms related to their ESG performance. This study contributes to this strand by providing a comprehensive examination of how firms' ESG performance may affect their investment decision-making. Third, concerning the overinvestment literature, many studies, including Richardson (2006), Wei et al. (2019), and Irawan and Okimoto (2020), discuss how economic conditions and firms' internal financial factors may cause overinvestment. This study extends this literature block by identifying the relationship between ESG factors and overinvestment behaviour. These three contributions highlight the importance of this study.

Three analyses were performed in this study. The first analysis examines the relationship between ESG scores and firm values measured by Tobin's $Q$. The second analysis focuses on overinvestment, which implements the framework from Richardson (2006) to identify over- and underinvestment among firms in the sample. The third analysis investigated the relationship between ESG scores and overinvestment. For this analysis, the framework from Irawan and Okimoto (2020) was adopted and extended.

This study has several significant findings. The first analysis shows a positive relationship

between ESG performance and firm values (Tobin's $Q$), but this positive relationship has only been observed in recent years. Analysis at the pillar level shows that social and controversial pillars are the most significant among the four pillars in explaining firm valuation. The second analysis indicates the vital role of firms' internal financial factors in influencing investment decision-making. More importantly, the results show that Tobin's $Q$ is positively related to firms' investment, confirming that firms with higher investment opportunities tend to invest more. Even so, the third analysis demonstrates that there is no strong relationship between ESG performance and firm overinvestment behaviour. This finding posits that although firms with higher ESG performance have relatively higher valuation (high Tobin's $Q$) and investment opportunities, they do not have a higher tendency to overinvest.

The remainder of this paper proceeds as follows. Section 2 reviews a block of literature that is fundamental to this study. Section 3 discusses the dataset, and Section 4 details the methods implemented for the three analyses. Section 5 lists the empirical results and discusses them in the context of the current literature strand. Finally, section 6 concludes the paper.

# 2 Literature Review

## 2.1 ESG Performance and Market Value

Literature discussing the relationship between ESG performance and firm value is emerging. The majority have found a positive relationship between ESG performance and firm value. For example, Hartzmark and Sussman (2019) provide strong evidence that investors attract value sustainability. Specifically, they found that sustainability warranties a better future performance. Aligned with this, Li et al. (2018) find that ESG report disclosure positively affects firm value. Many other studies, such as Wong et al. (2020), Fatemi et al. (2018), Mervelskemper and Streit (2017), and Dimson et al. (2015), also find similar results. In addition, Auer (2016) finds that excluding firms with bad ESG performance or unrated performance does not negatively affect the overall portfolio performance. However, Duque-Grisales and Aguilera-Caracuel (2019) find that the relationship is significantly negative for firms in Latin countries.

Related to ESG sub-indices, Aouadi and Marsat (2018) find that ESG controversies score do not have a direct effect on firm value, although the interaction between controversies score and other variables appears to be highly significant and positive. Li et al. (2019) document that firms tend to engage only in symbolic instead of substantive CSR activities and this factor, along with the low level of controversies, contribute positively to market value. Nirino et al. (2021) document a positive relationship between controversies score and market value.

Furthermore, many studies discuss the relationship between corporate social responsibility (CSR), a component of the ESG score, and firm value. Lins et al. (2017) find that firms with high CSR scores have higher stock returns, profitability, growth, and sales per employee. Ferrell et al. (2016) also find a significantly positive relationship between CSR performance and firm value. Conversely, Krüger (2015) find that positive news about firms' CSR resonates negatively (though to a weak extent) with investors due to agency problems, while negative news resonates strongly negatively.

In terms of technical specifications, Tobin's $Q$ is an extremely popular measure of a firm's market value. Many studies discussed above employ Tobin's $Q$ as the primary measure of firm value, such as Wong et al. (2020), Fatemi et al. (2018), Aouadi and Marsat (2018), Li et al. (2018), and Dimson et al. (2015).

## 2.2 Market Value and Corporate Investment

The basic logic of the $Q$-theory of investment argues that firms with high Tobin's $Q$ will have a greater opportunity to invest. This logic suggests that firms with higher $Q$ have greater access to funding in the form of either equity or debt issuance. This is because if the market regards the investment that the firm wants to make as profitable in the future, the share price of the firm will tend to increase (Tobin (1969), Tobin and Brainard (1976), Yoshikawa (1980), Hayashi (1982), Abel and Eberly (1994)). Furthermore, Chirinko (1993) outlines the poor empirical performance of the $Q$ theory of investment. Later, many studies such as Barnett and Sakellaris (1999), Kalyvitis (2006), and Abel and Eberly (2011) improve the empirical performance of the theory. In this study, the logic suggests a strong nexus between market value and investment: firms with higher $Q$ tend to invest more.

Empirically, many studies document the relationship between market value and corporate investment. Foucault and Fresard (2014) find that peer valuation is significantly related to a firm's investment decision. Asker et al. (2015) find that short-termism tendency puts pressure and distorts investment decisions of publicly-listed firms. Their results show that publicly listed firms are less responsive to investment opportunities and, in general, invest less.

Furthermore, Cao et al. (2019) find that financial frictions weaken the relationship between $Q$ and investment. Lin et al. (2018) find that interest rate explains the relationship between $Q$ and investment. Chalak and Kim (2020) study the role of Tobin's $Q$ as a proxy of marginal $q$ in affecting firms' investment, saving, and debt. Furthermore, Jinji et al. (2019) examine the preference of firms with high Tobin's $Q$ toward foreign direct investment and foreign outsourcing. Wu et al. (2021) examine the role of endogenous discounting to explain the relationship between Tobin's $Q$ and investment.

## 2.3 ESG Performance and Corporate Investment

A recent study by Duque-Grisales and Aguilera-Caracuel (2019) find that for certain firms, attaining high ESG performance requires a significant level of investment. The amount of investment can be substantial, which may hamper the financial performance of firms. In line with their study, Rassier and Earnhart (2010) argue that to increase the environmental standard of production of a firm and adjust with tighter regulation, a firm needs to make substantial investments. On many occasions, this investment is excessive and tends to drive the firm to over-compliance.

Furthermore, Sueyoshi and Goto (2009) find that environmental investment, be it long-term (investment) or short-term (expenditure), are not significant or positively related to firms' financial performance. This finding emphasises that increased costs of environmental investment do not benefit firms financially both in the short and long term. This case is especially true for industries that require a high upfront investment, such as electricity generation. Concerning social pillars, Reimann et al. (2012) find that pressures from local stakeholders will induce firms to invest socially to gain social legitimacy. In other words, firms need to spend more on achieving higher social performance. The above studies are substantial to make an important inference: to perform well in ESG, firms need to make higher investments. The question then is regarding whether this induces overinvestment.

Literature on overinvestment has recently emerged, especially after the global financial crisis (GFC) in 2008. In general, overinvestment is defined as a phenomenon in which firms' investment exceeds the amount they should invest, given their financial condition and economic situation. Although overinvestment could yield a higher return in the short run, it might have an adverse impact in the long run by consuming future demand ahead of time, which would be potentially

damaging to the economy. Therefore, it is instructive to investigate the tendency of firms to overinvest and their possible factors.

Attempts to explain firms' overinvestment behaviours can be traced to Fazzari et al. (1988), who identify the financial constraints proxied by a dividend payout as a cause of overinvestment. Following their study, other studies, such as Bond and Meghir (1994), Chapman et al. (1996), Whited and Wu (2006), Almeida and Campello (2007), Carpenter and Guariglia (2008), and Wang et al. (2016), have examined the role of financial constraints in overinvestment by using various proxies of financial constraints.

Richardson (2006) introduces an accounting-based framework to measure the overinvestment phenomenon. He defines overinvestment as a form of investment at an amount that exceeds the normal or expected level, given the firm's characteristics and economic conditions. Specifically, the residual from the firms' estimated investment function is defined as misinvestment. A positive value of this residual represents overinvestment, while a negative value represents underinvestment. This definition is among the most popular measures because of its straightforward and easy-to-compute characteristics, requiring only balance sheet information. Studies that adopt this framework for overinvestment analysis include Zhang and Su (2015), Guariglia and Yang (2016), Wei et al. (2019), Yu et al. (2020), and Irawan and Okimoto (2020). For example, Irawan and Okimoto (2020) analyse the overinvestment phenomenon among natural resource companies across G20 countries and find that the overinvestment phenomenon is both sector- and time-specific. Further, macroeconomic uncertainties play an essential role in explaining firms' over- and underinvestment behaviour. This study contributes to the literature by examining whether ESG scores play a role in inducing firms' overinvestment.

# 3 Data

This study involves companies that are constituent members of the S&P Global 1200 index, which capture approximately 70% of global market capitalisation. A total of 1,045 companies were included in the analysis after excluding several companies that were dual-listed. Furthermore, following the Industrial Classification Benchmark (ICB), companies are grouped into 11 sectors.[1] The data are in annual frequency, covering the period from 2002 to 2019.

## 3.1 ESG Performance

For ESG performance, this study employs the ESG score provided by Refinitiv Datastream. The scores are reported annually, with a total of more than 450 ESG metrics assessed. The earliest data were collected in 2002.[2]

There are four levels of ESG scores provided by Refinitiv Datastream. The highest level, or level 1, is the *ESG combined score* , which is the highest aggregation of all metrics assessed. Level 2 comprises two broad scores. These are the *ESG Score* and *ESG Controversies Score*. Level 3 categories are called pillars. The ESG Score comprises the three main ESG pillars: environmental ($E$), social ($S$), and governance ($G$). Further, in level 4, the environmental pillar comprises three categories: resource use, emissions, and innovation. The social pillar comprises four categories: workforce, human rights, community, and product responsibility. The governance pillar comprises three categories: management, shareholders, and corporate social responsibility (CSR). Meanwhile,

[1] The eleven sectors are as follows: (1) basic materials; (2) consumer discretionary; (3) consumer staple; (4) energy; (5) financials; (6) health care; (7) industrials; (8) real estate; (9) technology; (10) telecom; and (11) utilities.

[2] For detailed information about the ESG scores, see Refinitiv Datastream (2020).

the ESG Controversies Score comprises only one pillar in level 3, the *ESG Controversy*. In level 4, this pillar comprises 10 controversial categories, which are aggregated as one pillar.

Specifically, this study conducts an analysis using data at level 1 (ESG combined score) and level 3 (ESG pillars). There are two reasons for focusing on these two levels. The first is to ease the analysis because it is difficult to find a general pattern of analysis if numerous categories are involved. Second, the two levels are consistent and comparable to many other studies. Many studies have analysed ESG scores from various sources, which may involve different metrics of analysis. Nevertheless, in general, all are aggregated into the three main pillars of the ESG: the environment, social, and governance pillars. The descriptive statistics of the ESG scores are presented in Table 1.

[Table 1].

### 3.2 Firm-Level Financial Data

For all firm-level variables, the data are in annual frequency, mainly referring to the end-of-year financial statement for each year. All variables are transformed into log natural forms or divided by total assets. All data are retrieved from Refinitiv Datastream in the local currency where the firm is listed. There are nine variables employed from the firm financial statement: (1) total book assets, (2) market capitalisation, (3) book equity, (4) book liabilities, (5) gross income, (6) total sales, (7) capital expenditure, (8) cash dividend, and (9) cash.[3] The descriptive statistics of the variables are presented in Table 1.

### 3.3 Macroeconomic Data

The firms analysed in this study come from various countries. Thus, it is crucial to acknowledge country heterogeneity in the analysis. To this end, macroeconomic data at both the world and country levels are employed.

At the global level, three variables are employed. The first is the annual world GDP growth ($WGDP$), which represents the global business cycle. Data were retrieved from the World Bank. The second variable is the annual commodity price growth ($COMM$), which represents the commodity price cycle. The Goldman Sachs Commodity Index (GSCI) is employed as a proxy for commodity prices. The GSCI is chosen because it is one of the most popular commodity price indices in the financial market. In addition, it is based on the future instead of spot prices. This characteristic is essential as a proxy for the expectation of future prices. The GSCI is available almost in real-time, and the annual average of the daily closing price is used to calculate commodity price growth. The third variable is the global economic policy uncertainty ($GEPU$) index from Davis (2016). This index is a media-based index measuring global economic policy uncertainty based on words related to uncertainty found in key mass media worldwide.[4]

At the country level, three variables are employed. The first two variables are the annual home country GDP growth ($HGDP$) and annual home country inflation rate ($INFL$), which represent the home country's business cycle and inflation, where the company domiciles. These data were retrieved from the World Bank. The third is the Worldwide Governance Index ($WGI$), which is an average of six categories: (1) voice and accountability; (2) political stability and the absence

[3]Respective Refinitiv Datastream code for each variable is as follows: (1) total book assets - WC02999, (2) market capitalization - WC08001, (3) book equity - WC03995, (4) book liabilities - WC03351, (5) gross income - WC01100, (6) total sales - WC01001, (7) capital expenditure - WC04601, (8) cash dividend - WC04551, and (9) cash - WC02003.

[4]The data are updated monthly by Davis (2016) and published on the respective website of the author at https://www.policyuncertainty.com/global_monthly.html.

of violence/terrorism; (3) government effectiveness; (4) regulatory quality; (5) the rule of law; and (6) control of corruption. The $WGI$ ranges from -2.5 to 2.5, where a higher value indicates better governance. For ease of analysis, the $WGI$ was inverted by multiplying with -1. Thus, a higher value represents higher uncertainty.

# 4 Methodology

Based on the literature discussed in section 2, this study formulates three analyses, as described in Figure 1. The first analysis focuses on the relationship between ESG performance and firm value. The second analysis focuses on the overinvestment patterns of firms in the dataset, which are analysed using the framework of those Richardson (2006). From this analysis, the overinvestment dummy will be acquired, which refers to whether each company is either over- or underinvesting at every point in time. The third analysis focuses on whether ESG performance can explain the overinvestment phenomenon of companies in the sample. This analysis extends the framework of Irawan and Okimoto (2020), which was developed to analyse how macroeconomic uncertainty might induce overinvestment in natural resource companies worldwide.

[Figure 1]

Each analysis in this study adopts and extends the methodologies from the literature. All three analyses use firm-level data, especially the first and second analyses. Such settings make analyses prone to endogeneity and reverse causality issues. To address this concern, following the strategy implemented by Richardson (2006), all independent variables for each analysis are lagged by one period.

## 4.1 ESG and Firm Value

In this analysis, the relationship between ESG performance and firm value is examined. The dependent variable for this analysis is Tobin's $Q$, which represents the firm market value of assets divided by the book value of assets, as follows:

$$Tobin's\ Q = \frac{Market\ Equity + Book\ Liabilities}{Book\ Equity + Book\ Liabilities}. \tag{1}$$

The basic framework for analysis is adapted from many studies which analyse the relationship between firm value and ESG performance, such as Aouadi and Marsat (2018), Fatemi et al. (2018), and Li et al. (2018). The estimation is conducted using panel ordinary least squares (OLS) with fixed effects implemented for both firm and year. All independent variables were lagged for one period to avoid endogeneity. The equation estimated for this analysis employing the level 1 ESG score is as follows:

$$\begin{aligned} Q_{i,t} = {} & \beta_0 + \beta_1 COMB_{i,t-1} + \beta_2 SIZE_{i,t-1} + \beta_3 ROA_{i,t-1} + \beta_4 SALES_{i,t-1} \\ & + \beta_5 LEV_{i,t-1} + \beta_6 CAPX_{i,t-1} + \beta_7 DIV_{i,t-1} + \Sigma FRID + \Sigma YRID + e_{i,t}. \end{aligned} \tag{2}$$

where subscript $i$ denotes firm, and subscript $t$ denotes the year. The term $Q$ is Tobin's $Q$, as in (1). The term $COMB$ refers to the combined ESG score. Meanwhile, for the analysis employing level 3 ESG scores, this term is replaced by the four ESG pillar terms: environmental ($ENV$), social ($SOC$), corporate governance ($CGV$), and controversies ($CTR$).

Other variables are control variables that have been commonly employed in previous studies. Term $SIZE$ refers to log-transformed total assets, while the term $ROA$ refers to the return on

assets, calculated as gross income divided by total assets. $SALES$ represents total sales divided by the total assets. $LEV$ represents the ratio of total liabilities to total assets. $CAPX$ represents total capital expenditure divided by total assets. $DIV$ represents the total cash dividend payout divided by total assets. $\Sigma FRID$ represents firm fixed effects, and $\Sigma YRID$ represents year fixed effects. Finally, the term $e$ represents the residuals.

### 4.2 Overinvestment

The analysis in this stage aims to examine the overinvestment patterns of firms in the sample during the sample period. Simultaneously, this analysis also focuses on how market value influences firms' investment decisions.

The framework from Richardson (2006) is implemented for this purpose. This framework is extremely popular for measuring overinvestment, mainly because of its intuitive definition and ease of implementation, which requires only financial statement information. This framework has been implemented in many studies, such as Zhang and Su (2015), Guariglia and Yang (2016), Wei et al. (2019), Yu et al. (2020), and Irawan and Okimoto (2020). Capital expenditure divided by total assets ($CAPX$) is employed as a proxy for new firm investment. This proxy adopts the practice from Richardson (2006), which proxies investment as the total new capital in the firm. Another alternative would be to use stock or total investments in the company. However, the analysis in this paper focuses on how companies decide on new investments, and therefore, the flow of investment is a better representative.

This proxy of investment is used to predict the investment functions of firms in the sample. The equation is estimated as panel OLS with firm and time fixed effects. Specifically, the investment function regression of firms is as follows:

$$\begin{aligned} CAPX_{i,t} &= \beta_0 + \beta_1 CAPX_{i,t-1} + \beta_2 Q_{i,t-1} + \beta_3 LEV_{i,t-1} + \beta_4 CASH_{i,t-1} \\ &\quad + \beta_5 SIZE_{i,t-1} + \beta_6 RTRN_{i,t-1} + \Sigma FRID + \Sigma YRID + \epsilon_{i,t}. \\ &= \beta_0 + \beta_1 CAPX_{i,t-1} + \beta_2 Q_{i,t-1} + \beta_3 LEV_{i,t-1} + \beta_4 CASH_{i,t-1} \\ &\quad + \beta_5 SIZE_{i,t-1} + \beta_6 RTRN_{i,t-1} + \Sigma YRID + \mu_{i,t}. \end{aligned} \tag{3}$$

where $CASH$ represents total cash divided by total assets, and $RTRN$ is the annual growth in the market capitalisation of the firm. Designs of the estimation adopt the framework from Richardson (2006), including the choice of independent variables. All independent variables are lagged by one year to avoid the endogeneity problem, as in Richardson (2006).

The last term, $\mu$, technically the residual ($\epsilon$) plus firm fixed effects ($\Sigma FRID$), is the proxy of over- and underinvestment. A positive value of $\mu$ represents overinvestment, and a higher value indicates a higher degree of overinvestment. Conversely, a negative value of $\mu$ represents underinvestment, and a more negative value indicates a higher degree of underinvestment.

### 4.3 ESG and Overinvestment

The third analysis focuses on examining whether ESG performance can explain over- and underinvestment behaviour observed in the previous analysis. To this end, this study employs the framework of Irawan and Okimoto (2020), who examines the impact of macroeconomic uncertainty on firm overinvestment behaviour. In this framework, the proxy of overinvestment, $\mu$, based on Equation (3), is transformed into a dummy variable, $OVIT$, as follows:

$$OVIT_{i,t} = \begin{cases} 1 & if \quad \mu_{i,t} > 0 \\ 0 & if \quad \mu_{i,t} < 0 \end{cases} \tag{4}$$

In other words, overinvestment is proxied by value 1, while underinvestment is proxied by value 0. Furthermore, the value of $OVIT$ is employed as the dependent variable for the estimation. The estimation is conducted using a panel probit with firm and year fixed effects. The equation estimated for this analysis when employing level 1 ESG score is as follows:

$$\begin{aligned} Prob(OVIT_{i,t} = 1) = \Phi\Big(&\beta_0 + \beta_1 COMB_{i,t-1} + \beta_2 OVIT_{i,t-1} + \beta_3 COMM_{i,t-1} \\ &+ \beta_4 WGDP_{i,t-1} + \beta_5 HGDP_{i,t-1} + \beta_6 GEPU_{i,t-1} \\ &+ \beta_7 WGI_{i,t-1} + \beta_8 INFL_{i,t-1} + \Sigma FRID + \Sigma YRID\Big), \end{aligned} \tag{5}$$

where $OVIT$ denotes the overinvestment dummy. For analyses employing level 3 ESG scores, the term $COMB_{i,t-1}$ is replaced by the four ESG pillar terms: environmental ($ENV$), social ($SOC$), corporate governance pillar ($CGV$), and controversies pillar ($CTR$). Other variables are the macroeconomic variables described in the previous section, which serve as controls.

# 5 Empirical Results

This section presents the empirical results of the three analyses conducted in this study. The first analysis examines the relationship between ESG performance and firm value, as assessed by Tobin's $Q$. The second analysis discusses the overinvestment patterns of firms in the sample. Finally, the third analysis examines the results from the previous analysis further by investigating the connection between ESG performance and the over- and underinvestment of firms in the sample. For each analysis, results are presented based on the ESG score (combined score and pillars) and sectors.

## 5.1 ESG and Firm Value

Many studies exhibit a positive relationship between ESG performance and firm value, such as Hartzmark and Sussman (2019), Li et al. (2018), Wong et al. (2020), Mervelskemper and Streit (2017), Dimson et al. (2015), Aouadi and Marsat (2018), and Fatemi et al. (2018). This analysis aims to replicate those studies for firms in the dataset and provide additional insights by considering the ESG pillars and two periods. The framework from Aouadi and Marsat (2018) is adopted for the analysis as expressed by Equation (2). The dependent variable for this analysis is Tobin's $Q$, calculated using Equation (1).

Tables 2-4 present results of the estimation using combined ESG score ($COMB$) for the following: (1) full period, which includes the period 2002–2019; (2) before 2011, which includes the period 2002–2010; and (3) after 2011, which includes the period 2011–2019.[5] Each table comprises the results of the full sample and 11 sectors. Table 2 shows that, for the full period, $COMB$ is found to be statistically significant for the full sample, consumer discretionary, consumer staple, financials, technology, and utilities sectors, with positive signs. This indicates straightforward results that confirm the findings of previous studies, which outline the positive connection between ESG performance and firm value.

[Table 2]

[Table 3]

[5]The sample is simply divided in the middle into two. This choice is innocuous in the sense that even if the analysis divides the sample at different timings (e.g. 2008 or 2012), the results are relatively stable.

[Table 4]

However, Table 3, which presents the results before the 2011 period, indicates that $COMB$ is not significant for all sectors, including the full sample. Meanwhile, the results after the 2011 period show similar results from the full period. Specifically, the results indicate that $COMB$ is statistically significant and has a positive sign for the full sample, consumer discretionary, consumer staple, financials, technology, and utilities sectors, at least at the 10% significance level. In general, based on the results from the periods before and after 2011, it could be argued that the connection between ESG performance and firm value is only found after 2011.

For other variables that serve as controls, some are found to be statistically significant (Table 2–4). In general, $SIZE$ is found to be significant with a negative sign in the full period, in the periods before and after 2011, for many sectors. These results indicate that large firms generally have a lower $Q$. $ROA$ is found to be significant with positive signs for all periods in many sectors. These results are predictable because it is reasonable that firms with high profitability have higher $Q$. $LEV$ is significant mainly in the periods after 2011 for the full sample, consumer discretionary, financials, health care, industrials, technology, and telecommunication sectors, with a positive sign. In general, $DIV$ is significant for the full period and the periods after 2011, with a positive sign, which is logical because firms with a higher dividend rate have higher $Q$. Meanwhile, $SALES$ and $CAPX$ are, in general, not significant or mixed signs for all periods and most sectors.

Tables 5-7 present estimation results using ESG pillars as regressors, along with other control variables. There are four ESG pillars included in the analysis: environment ($ENV$), social ($SOC$), corporate governance ($CGV$), and controversies ($CTR$). In general, the results indicate the remarkable differences before and after 2011.

[Table 5]

[Table 6]

[Table 7]

For the full period, $ENV$ is found to be significant only for the energy and industrial sectors, with negative and positive signs (Table 5). The pillar $CGV$ is found to be significant only for the healthcare and technology sectors, with negative and positive signs. In general, $SOC$ is found to be significant with positive signs for all the sectors except for the industrial sector. $CTR$ is found to be significant and with positive signs for the full sample, basic materials, health care, technology, and utilities sectors. Thus, in general, it can be inferred that $ENV$ and $CGV$ are not significant in explaining the $Q$ of firms in the sample. Conversely, $SOC$ and $CTR$ are, in general, significant and have positive signs.

For the period before 2011, $ENV$ is significant for the two sectors with mixed signs (Table 6). $CGV$ is not significant in any sector. $SOC$ is significant only for the three sectors with mixed signs. Meanwhile, $CTR$ is not significant for all sectors except consumer discretionary. Thus, in general, it is difficult to find any clear signs of the role of ESG performance in affecting $Q$ of companies in the sample before the 2011 period.

For the period after 2011, the pattern resembles the results for the full period. $ENV$ is significantly positive only in the healthcare sector. $CGV$ is significant for the full sample, health care, and telecommunication sectors with negative signs and the utilities sector with positive signs. $SOC$ is significantly positive for the full sample, consumer staple, health care, technology, and utilities sectors and significantly negative for real estate. Meanwhile, $CTR$ is significant for the full sample, consumer staple, financials, telecommunication, and utilities sectors, all with positive signs except

telecommunication. Thus, in general, for the period after 2011, it could be inferred that $ENV$ is not significant, and $CGV$ is significant for some sectors, mostly with negative signs. Conversely, $SOC$ and $CTR$ have significantly positive impacts on firm values for many sectors, including the full sample. These results clearly indicate that ESG scores, particularly $SOC$ and $CTR$ pillars, play a more active role in determining firm values after 2011.

Furthermore, from the results presented in Table 7, it can be inferred that there are two sectors whose valuations are sensitive to ESG performance after 2011. The first is the healthcare sector, for which the environmental, social, and governance pillars are significant. Interestingly, the governance pillar was found to be negative for this sector. One explanation would be that better or stricter governance in this sector might incur a higher operating cost, thus compromising its firm value. The second sector is the utilities sector, for which the social, governance, and controversy pillars are significantly positive. Therefore, in this sector, ESG scores tend to play a relatively important role in determining firm value.

Several patterns can be inferred from this analysis. First, there are considerable proofs that show a positive relationship between ESG performance and firm value after 2011, but not before 2011, which confirms the results from many studies such as Hartzmark and Sussman (2019), Li et al. (2018), Wong et al. (2020), Mervelskemper and Streit (2017), Dimson et al. (2015), Aouadi and Marsat (2018), and Fatemi et al. (2018), with some additional evidence of structural change. This finding offers an important insight that the awareness of ESG factors as ESG investments has grown over the last decade. Second, as can be compared from the results based on the combined score ($COMB$) and the pillars ($ENV$, $SOC$, $CGV$, and $CTR$), analysis at the pillar level yields mixed results. $SOC$ and $CTR$ have significantly positive impacts on firm valuation. Specifically, the results of $CTR$ support previous studies, such as Aouadi and Marsat (2018), Li et al. (2019), and Nirino et al. (2021), which document a positive relationship between good controversies performance and market value. Moreover, the results after 2011 show that the relationship between $ENV$ and firm value is not significant for all sectors except the healthcare sector. Finally, $CGV$ is significant for some sectors with mostly negative signs, indicating that stricter governance in those sectors might incur a higher operating cost and lower firm value.

### 5.2 Overinvestment Pattern

This analysis examines the overinvestment patterns of companies in the sample. The basic framework employed for this analysis is adopted from Richardson (2006), based on residuals from firm investment functions (3). Technically, the investment functions for all firms are estimated together as a one-panel regression using OLS with both firm and year fixed effects. The dependent variable for this analysis is $CAPX$, which is calculated as capital expenditure divided by total assets. The results in the previous subsection suggest that ESG scores have become important factors for firm value only after 2011. Therefore, it is meaningful to examine the overinvestment pattern and its relationship with ESG scores only after 2011. For this reason, in this and the following subsections, we focus only on the sample collected after 2011

Table 8 presents estimation results of investment function (3) based on the sample after 2011. In general, all estimations have relatively high $R^2$, which indicates the high ability of the models to explain variation in the investment rate of companies in the sample. Lagged $CAPX$ is found significant with positive signs for all sectors. The positive sign indicates that firms with a high rate of investment in the previous year have a higher investment rate in the current year. $Q$ is significant for many sectors, with positive signs. The results indicate that firms with higher valuation have more opportunity to invest and therefore have a higher level of investment rate. $LEV$ is found significant for the full sample, consumer discretionary, energy, technology, financials, and utilities

sectors, all with negative signs. The negative sign indicates that firms with high leverage tend to have a lower investment rate. The results are considerably logical because debt is one of the main sources of investment. The other three variables, namely $CASH$, $SIZE$, and $RTRN$, are mostly insignificant with few exceptions. Therefore, those variables can be deemed as insignificant factors to explain the firms' investment after 2011. In sum, $CAPX$, $Q$, and $LEV$ can logically explain the reasonable fluctuation in investment taken by firms in the sample, although the results vary among variables and sectors. More specifically, while $CAPX$ has a positive sign for all sectors, $Q$ and $LEV$ have a significant impact on the firms' investment for several sectors with positive and negative signs, respectively.

We define misinvestment as the residual, $\mu$, of the investment function (3), or, more precisely, the sum of the firm fixed effect and error term of the estimated investment function. To see the pattern of misinvestment, we summarise $\mu$ by sector and country. For this analysis, to clearly capture the differences across sectors, we focus on the results of $\mu$ from the full sample.

Figure 2 presents $\mu$ grouped by sector. The figure shows the variety of misinvestment behaviour in each sector during the period after 2011. As can be seen, the energy, telecommunications and utilities sectors tend to overinvest during this period. Meanwhile, the financials, health care, industrial, and technology sectors are underinvested.

[Figure 2]

Figure 3 presents $\mu$ grouped by country of domicile. As can be observed, some countries tend to overinvest during the period after 2011, while others tend to underinvest. Countries that are observed as overinvesting are Austria, Colombia, Macao, Mexico, Norway, Papua New Guinea, Portugal, and South Korea. Conversely, Belgium, Bermuda, Finland, Hong Kong, Ireland, Isle of Man, New Zealand, Switzerland and United Kingdom are seen to be underinvesting during the period after 2011.

[Figure 3]

As the framework for the analysis uses residuals, and estimation is conducted in a panel setting, these results represent a comparison of the investment rate between sectors and countries in the observation. The variation between sectors and countries could be caused by several factors, including (1) the firm's fundamental characteristics, (2) economic conditions, and (3) macroeconomic uncertainties. Therefore, the third analysis, presented in the next section, examines the role of several variables from these factors in the overinvesting behaviour of the firm.

### 5.3 ESG and Overinvestment

The analysis in this section aims to test an essential hypothesis of this study: If firms with higher ESG performance get a higher valuation and therefore have bigger investment opportunities, do they tend to overinvest? To this end, the misinvestment residual ($\mu$) from the previous analysis is transformed into a dummy variable ($OVIT$) based on Equation (4) and then employed as the dependent variable for the analysis as expressed by Equation (5). The basic framework for this analysis was developed from Irawan and Okimoto (2020), which was initially used to analyse how macroeconomic uncertainties may induce overinvestment among natural resource firms worldwide. The framework is extended by adding ESG variables, both the combined score ($COMB$) and the pillars ($ENV$, $SOC$, $CGV$, and $CTR$). The samples are estimated together as one panel using probit estimation with both firm and year fixed effects. All regressors are lagged by one year to mitigate the endogeneity issue. As discussed, the analysis focuses on the period after 2011.

Table 9 shows results from the estimation results with $COMB$. In general, the McFadden $R^2$ shows that the estimations have considerable power to predict $OVIT$. However, there is only one strongly significant variable, the lagged $OVIT$. This finding indicates that current overinvestment behaviour is mainly due to the firms' overinvestment in the previous period. The variable of interest in this analysis, $COMB$, is not significant for almost all panels, except for the basic materials (-), financials (-), and health care (+) sectors. This finding implies that $COMB$ induces overinvestment behaviour only for the health care sector and reduces overinvestment for the basic materials and financials sectors.

[Table 9]

Other variables in the model, which are mostly macroeconomic variables both at the global and country levels, are generally weakly significant (Table 9). $COMM$ is significant only for the energy and financial sectors. $WGDP$ is significant only for the consumer discretionary (-) and real estate (+) sectors, which, respectively, indicate the counter- and procyclicality of these two sectors. $HGDP$ is significant only for the healthcare sector, with a negative sign, which implies the counter cyclicality of the sector. $GEPU$, which represents global economic uncertainty, is significant for the full sample and consumer discretionary panels, both with positive signs. Thus, it can be inferred that global economic uncertainty tends to induce overinvestment in these two panels. The country-level governance uncertainty proxy, $WGI$, is significant with positive signs for the energy, real estate, and telecommunication sectors and significant with a negative sign for the health care sector. A higher $WGI$ value represents a more inferior governance level. Thus, the general pattern is that poorer country-level governance induces overinvestment. The home country inflation rate, $INFL$, is significant, with negative signs for the consumer staple and telecommunications sectors.

Table 10 presents the estimation results with ESG pillars as regressors in the model. The lagged $OVIT$ is significant for almost all panels, with positive signs. $ENV$ is not significant for all panels. $CGV$ is significant for the health care (-), real estate (-), and utilities (+) sectors. $SOC$ is significant for the financials (-) and telecommunications (+) sectors. $CTR$ is significant for the basic materials (-), health care (+), and utilities (+) sectors. Thus, it could be inferred that there is a weak and sector-specific relationship between ESG pillars and overinvestment.

[Table 10]

From the analysis in this section, several patterns can be inferred regarding the relationship between ESG performance and the overinvestment behaviour of firms in the sample. First, there is no strong proof of the positive relationship between ESG performance and overinvestment behaviour. Second, even if there are several results of a significant relationship, they are sector-specific with mixed signs and thus could not be perceived as a general pattern.

# 6 Conclusion

In this study, we examine the relationship between firms' ESG performance and overinvestment. The sample of analysis is a constituent member of the S&P 1200 Index, which comprises companies with the largest capitalisation from around the world, capturing about 70% of the total global market capitalisation. The dataset covers the 2002–2019 period from annual frequency, with more emphasis on the 2011–2019 period.

The first analysis found a positive relationship between ESG performance and firm value (Tobin's $Q$), but this positive relationship is observed only after 2011. Our results support many

previous studies documenting a similar positive relationship but provide additional evidence that this relationship depends on the period. Moreover, analysis at the pillar level shows that $SOC$ and $CTR$ are the most significant pillars among the four in explaining firms' valuation. However, the results also indicate that the relationships are both sector- and period-specific, where the pattern is observed only after 2011.

The second analysis showed that internal firm factors play a significant role in determining firms' investment decisions. One important finding from this analysis confirmed that firms with higher $Q$ tend to invest more, as shown by the significant estimation results with positive signs. Furthermore, some sectors were identified to have overinvested in the sample period. They are energy, telecommunications, and utilities. Other sectors identified as underinvested during the sample period are the financials, health care, industrial, and technology sectors. In addition, based on the country of domicile, the estimation also showed that firms from Austria, Colombia, Macao, Mexico, Norway, Papua New Guinea, Portugal, and South Korea have overinvested in the period after 2011. Meanwhile, Belgium, Bermuda, Finland, Hong Kong, Ireland, Isle of Man, New Zealand, Switzerland and United Kingdom were identified as underinvesting.

The third analysis demonstrated that there is no strong pattern showing the relationship between ESG performance and firm overinvestment behaviour. Nevertheless, analysis at the pillar level shows some indication of a sector-specific relationship with mixed signs. In general, these results confirm that although firms with higher ESG performance have higher market valuation (Q), and thus high investment opportunities, this does not necessarily imply that these firms are prone to overinvestment.

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# 7 Figures

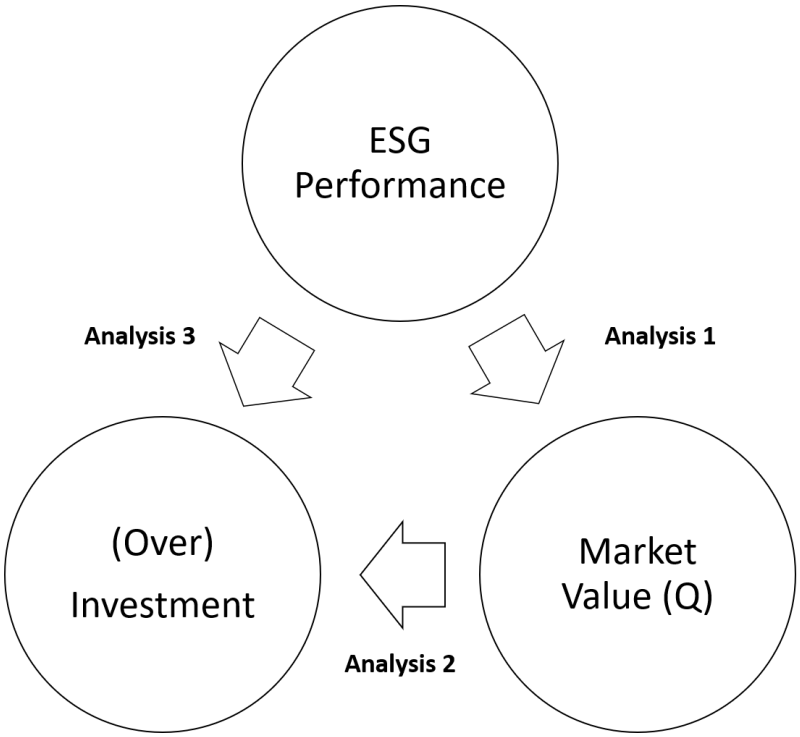


Figure 1: Framework of the Study

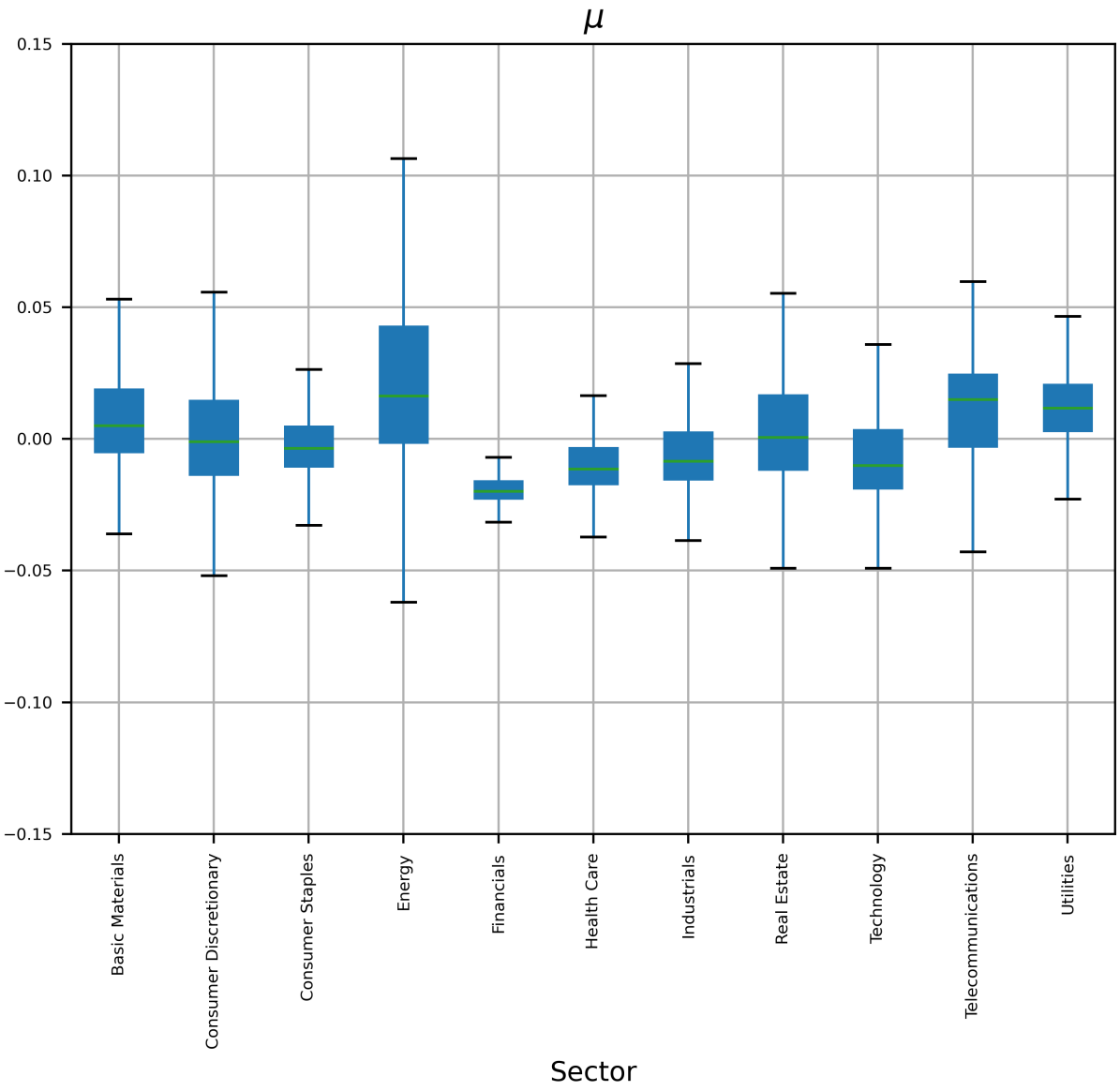


Figure 2: Misinvestment by Sector, After 2011

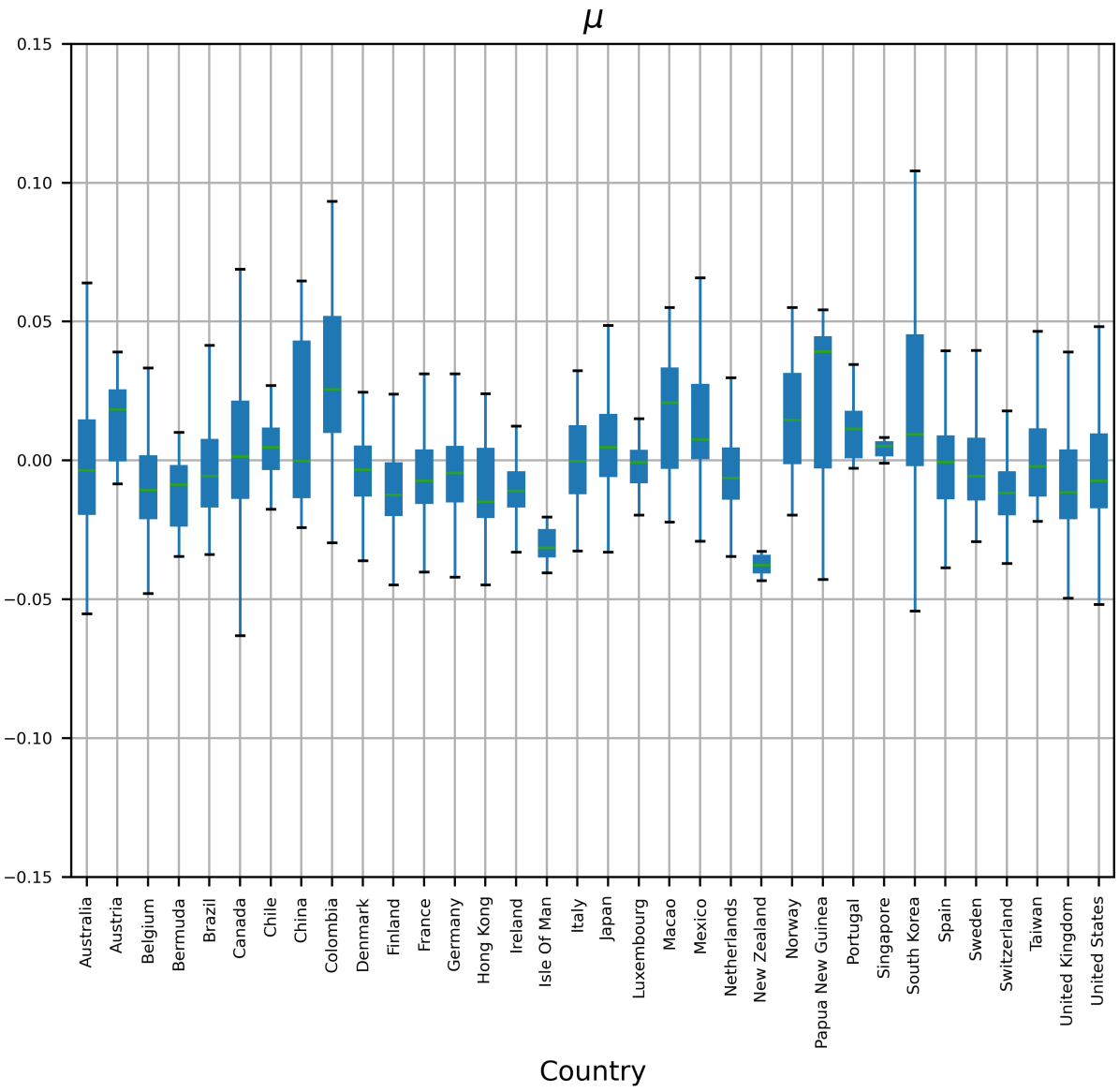


Figure 3: Misinvestment by Country, After 2011

# 8 Tables

Table 1: Descriptive Statistics

| Variable | Description | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $COMB$ | ESG Combined Score | 13,728 | 3.88 | 0.34 | 1.99 | 4.56 |
| $ENV$ | Environmental Pillar Score | 13,722 | 4.09 | 0.41 | 1.56 | 4.60 |
| $CGV$ | Corporate Govt Pillar Score | 13,722 | 4.08 | 0.40 | 1.32 | 4.60 |
| $SOC$ | Social Pillar Score | 13,728 | 3.99 | 0.44 | 1.23 | 4.60 |
| $CTR$ | Controversies Pillar Score | 13,722 | 3.32 | 1.20 | -2.21 | 4.42 |
| $Q$ | Tobin's Q | 16,073 | 1.99 | 3.31 | 0.40 | 284.36 |
| $SIZE$ | Log of Total Assets | 16,076 | 17.43 | 2.42 | 7.96 | 26.58 |
| $ROA$ | Gross Income / Total Assets | 14,864 | 0.27 | 0.20 | -1.32 | 1.57 |
| $SALES$ | Sales / Total Assets | 16,076 | 0.77 | 0.62 | -0.10 | 10.99 |
| $LEV$ | Liabilities / Total Assets | 16,070 | 0.25 | 0.18 | 0.00 | 3.39 |
| $CAPX$ | Capex / Total Assets | 16,076 | 0.05 | 0.04 | 0.00 | 0.52 |
| $DIV$ | Dividen / Total Assets | 16,074 | 0.40 | 0.23 | -6.17 | 1.11 |
| $CASH$ | Cash / Total Assets | 15,804 | 0.08 | 0.09 | 0.00 | 0.89 |
| $RTRN$ | Annual Market Cap Growth | 16,073 | 0.08 | 0.36 | -4.03 | 4.28 |
| $COMM$ | Annual Growth of GSCI Index | 14,747 | 0.00 | 0.03 | -0.07 | 0.03 |
| $WGDP$ | Annual World GDP Growth | 14,747 | 2.87 | 1.33 | -1.68 | 4.40 |
| $HGDP$ | Annual Home Country GDP Growth | 14,734 | 1.88 | 2.18 | -21.59 | 25.16 |
| $GEPU$ | Log of Glob Econ Pol Uncertainty | 14,747 | 4.76 | 0.33 | 4.14 | 5.22 |
| $WGI$ | Worldwide Governance Index | 14,734 | -1.32 | 0.33 | -1.97 | 0.87 |
| $INFL$ | Home Country Annual Inflation | 14,709 | 1.64 | 1.42 | -4.48 | 14.71 |

*Note:* Tobin's $Q$ is calculated as (Market Equity + Book Liabilities)/(Book Equity + Book Liabilities).

Table 2: ESG and Firms Value - Combined ESG Scores - Full Period

Dependent Variable = $Q_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $COMB_{i,t-1}$ | 0.1211*** | 0.1065 | 0.1180** | 0.1576** | -0.0914 | 0.4176** | 0.1791 | 0.0217 | -0.0464 | 0.3588** | 0.0358 | 0.0905*** |
| $SIZE_{i,t-1}$ | -0.4415*** | -0.6208*** | -0.5523*** | -0.118 | -0.3254*** | -0.3349 | -0.3953 | -0.0652 | -0.1321* | -1.0119*** | -0.4377*** | -0.1497** |
| $ROA_{i,t-1}$ | 1.9071*** | 1.0710** | 1.5272*** | 0.9772*** | 0.2504 | 5.5406** | 4.3049*** | 0.3343 | 2.7583** | 2.3535*** | 3.1422** | 1.0751*** |
| $SALES_{i,t-1}$ | -0.0496 | -0.3844 | -0.0461 | 0.0536 | 0.1054 | -0.5614 | -0.0876 | 0.2766** | 0.1291 | -0.4107 | -0.9905 | -0.2555*** |
| $LEV_{i,t-1}$ | 0.4973* | 0.5344 | 1.0327** | 0.2048 | -0.5283 | -2.1766 | 0.9865 | 0.5757** | 0.4366 | 1.1957 | -0.0266 | 0.1427 |
| $CAPX_{i,t-1}$ | 0.3498 | -1.0472 | -0.2579 | 1.6054 | 1.0289 | -0.3193 | -4.5018 | -0.1275 | 0.2885 | 3.6483 | 3.7909 | 0.5568 |
| $DIV_{i,t-1}$ | 3.2194** | 2.9218** | 1.79 | 7.2590*** | 2.9896** | 6.1676 | 12.1140* | 3.9294** | 2.2091 | -1.0916 | 2.3815** | 0.5205* |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 8.2978*** | 11.6233*** | 10.3097*** | 2.7001 | 7.0893*** | 6.0027 | 6.9295* | 2.1703** | 2.9264** | 17.6768*** | 9.2991*** | 3.2512*** |
| $OBS$ | 14050 | 1106 | 2676 | 1204 | 839 | 462 | 1287 | 2860 | 723 | 1278 | 646 | 969 |
| $R^2$ | 0.1802 | 0.2693 | 0.1916 | 0.3065 | 0.3984 | 0.3505 | 0.2778 | 0.2469 | 0.3316 | 0.3531 | 0.2631 | 0.3501 |
| $LL$ | -14400 | -776 | -2880 | -682 | -264 | -594 | -1920 | -1330 | 41 | -1740 | -506 | 511 |
| $AIC$ | 28800 | 1599 | 5809 | 1410 | 574 | 1232 | 3890 | 2699 | -36 | 3527 | 1058 | -976 |
| $BIC$ | 29000 | 1714 | 5945 | 1527 | 682 | 1323 | 4008 | 2836 | 69 | 3645 | 1161 | -864 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 3: ESG and Firms Value - Combined ESG Scores - Before 2011

Dependent Variable = $Q_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $COMB_{i,t-1}$ | 0.0125 | 0.0767 | -0.0375 | -0.0117 | -0.1476 | 0.1043 | 0.0711 | 0.0279 | -0.0565 | 0.0098 | 0.1171 | 0.0234 |
| $SIZE_{i,t-1}$ | -0.5305*** | -0.0817 | -1.0757*** | -0.2307** | -0.1945* | -0.9364* | -0.2762 | -0.1872** | -0.2560*** | -1.2835*** | -0.7976 | -0.2220*** |
| $ROA_{i,t-1}$ | 0.4499** | 0.6025 | -0.3879 | 0.8990** | -0.9366** | 2.2555 | 2.3370*** | -0.1367 | 1.7997 | 2.4129** | 2.0378** | 0.5666** |
| $SALES_{i,t-1}$ | -0.1192** | -0.2228 | -0.1035* | 0.014 | -0.0096 | 0.7701 | -0.6384 | -0.0153 | -0.3920* | -1.3983** | -0.882 | -0.2799** |
| $LEV_{i,t-1}$ | -0.6076* | -0.3823 | 0.3666 | -0.1599 | -0.4562 | -6.1511*** | -0.64 | -0.2076 | -0.4241 | -0.3818 | -0.2739 | -0.1828 |
| $CAPX_{i,t-1}$ | -0.4443 | -2.8541 | -2.4683** | -3.1351* | -0.728 | -6.3224 | -1.8874 | -0.1527 | -0.1369 | 5.1012 | 5.9683* | 0.3637 |
| $DIV_{i,t-1}$ | -1.5427** | -2.4933* | -2.0855 | -0.7626 | 1.4566 | 15.4004 | 0.726 | 3.2628 | -2.0585 | -2.3077 | 1.0869 | -0.1669 |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 11.0715*** | 3.1159 | 20.6750*** | 5.8192*** | 5.6356*** | 18.4396* | 7.0414* | 4.8247*** | 5.7152*** | 24.4906*** | 15.5596* | 5.0095*** |
| $OBS$ | 5338 | 415 | 1006 | 474 | 313 | 109 | 491 | 1131 | 253 | 478 | 270 | 398 |
| $R^2$ | 0.197 | 0.1473 | 0.2631 | 0.3191 | 0.4616 | 0.5168 | 0.3225 | 0.2529 | 0.5249 | 0.3575 | 0.2712 | 0.4868 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 4: ESG and Firms Value - Combined ESG Scores - After 2011

Dependent Variable = $Q_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $COMB_{i,t-1}$ | 0.1041*** | 0.0143 | 0.1206* | 0.1719* | -0.0538 | 0.2204* | 0.4116 | 0.0108 | 0.0002 | 0.2551* | -0.1212 | 0.0861*** |
| $SIZE_{i,t-1}$ | -0.3100*** | -0.3363** | -0.3149 | -0.1067 | -0.3607*** | -0.3057* | -1.0782** | -0.0295 | -0.0622 | -0.5791*** | -0.1467 | -0.0386 |
| $ROA_{i,t-1}$ | 2.2019*** | 1.4379*** | 2.3558*** | 1.4650* | 0.1138 | 8.2807*** | 3.3498** | 0.9298* | 1.3707 | 2.1135* | 0.9642* | 1.2074** |
| $SALES_{i,t-1}$ | 0.0955 | 0.029 | -0.1242 | -0.0043 | 0.0623 | -3.7130*** | -0.1788 | 0.4731** | 0.3877 | 0.7870* | -0.2854 | 0.0661 |
| $LEV_{i,t-1}$ | 1.2890*** | -0.0189 | 1.1230* | 0.3285 | -0.9099* | 2.0494** | 3.2811* | 0.6959** | 0.7035 | 2.3145** | 1.0873** | 0.1339 |
| $CAPX_{i,t-1}$ | 0.1741 | -0.1966 | -0.5162 | -0.1057 | 0.6364 | 13.2845 | -1.2791 | -1.2668 | -0.023 | -0.2632 | 0.9663 | 0.1948 |
| $DIV_{i,t-1}$ | 2.1046** | 1.3296** | 0.4649 | 4.3279*** | 2.4024 | 7.1147 | 7.4665 | 2.6369** | 0.1683 | 0.2261 | 0.5975 | 0.5338*** |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 5.6330*** | 7.0464*** | 5.8793 | 2.4022 | 7.9303*** | 5.2370* | 16.6870** | 1.2714 | 1.8507 | 9.2815*** | 4.1702** | 1.2159 |
| $OBS$ | 8712 | 691 | 1670 | 730 | 526 | 353 | 796 | 1729 | 470 | 800 | 376 | 571 |
| $R^2$ | 0.1461 | 0.1927 | 0.1678 | 0.2223 | 0.2164 | 0.4469 | 0.2077 | 0.2531 | 0.2477 | 0.2978 | 0.1751 | 0.2947 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 5: ESG and Firms Value - ESG Pillars - Full Period

Dependent Variable = $Q_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ENV_{i,t-1}$ | 0.0218 | -0.0077 | 0.0149 | -0.0831 | -0.2209** | 0.2346 | 0.2012 | 0.1234** | -0.0872 | -0.207 | -0.1485 | 0.0224 |
| $CGV_{i,t-1}$ | -0.0491 | -0.0566 | -0.0039 | -0.0011 | -0.0586 | 0.2208 | -0.7021*** | -0.0219 | 0.0526 | 0.2870** | -0.1113 | 0.0361 |
| $SOC_{i,t-1}$ | 0.1439*** | 0.1291 | 0.1099 | 0.2299*** | 0.0514 | -0.0004 | 0.5854** | -0.0874** | -0.077 | 0.1752 | -0.0083 | 0.0821** |
| $CTR_{i,t-1}$ | 0.0241*** | 0.0293* | 0.0041 | 0.0281 | -0.0043 | 0.0751 | 0.0861** | 0.0044 | -0.0079 | 0.1237*** | 0.0253 | 0.0163*** |
| $SIZE_{i,t-1}$ | -0.4437*** | -0.6174*** | -0.5552*** | -0.1381 | -0.3130*** | -0.3475 | -0.4761* | -0.0752 | -0.1257* | -0.9798*** | -0.3815** | -0.1519** |
| $ROA_{i,t-1}$ | 1.9087*** | 1.0297** | 1.5428*** | 0.9468*** | 0.251 | 5.5734** | 4.2247*** | 0.3339 | 2.6933** | 2.3513*** | 3.1563** | 1.0187*** |
| $SALES_{i,t-1}$ | -0.05 | -0.3786 | -0.0498 | 0.0435 | 0.1175 | -0.5707 | -0.1583 | 0.2685** | 0.1507 | -0.3792 | -0.9288 | -0.2534*** |
| $LEV_{i,t-1}$ | 0.5100* | 0.5525 | 1.0426** | 0.2033 | -0.5712 | -2.2018 | 1.0967 | 0.5642** | 0.4166 | 1.2116* | 0.0941 | 0.1276 |
| $CAPX_{i,t-1}$ | 0.2864 | -1.0785 | -0.3329 | 1.4298 | 1.0498 | 0.2321 | -3.6516 | -0.1633 | 0.2276 | 3.6769 | 3.8091 | 0.545 |
| $DIV_{i,t-1}$ | 3.1757** | 2.8594** | 1.734 | 7.2235*** | 3.1814** | 5.6034 | 10.498 | 3.9633** | 2.1436 | -1.0865 | 2.3111** | 0.5103* |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 8.2536*** | 11.6128*** | 10.3234*** | 3.0215 | 7.4364*** | 5.8426 | 8.2763** | 2.3563** | 3.1302** | 17.0281*** | 9.2909*** | 3.0457** |
| $OBS$ | 14044 | 1106 | 2676 | 1204 | 839 | 462 | 1287 | 2860 | 723 | 1272 | 646 | 969 |
| $R^2$ | 0.1814 | 0.2717 | 0.1913 | 0.3127 | 0.4063 | 0.3517 | 0.3151 | 0.2512 | 0.3416 | 0.36 | 0.2697 | 0.354 |
| $LL$ | -14400 | -774 | -2880 | -676 | -258 | -594 | -1890 | -1320 | 46 | -1730 | -503 | 514 |
| $AIC$ | 28800 | 1601 | 5816 | 1405 | 568 | 1237 | 3827 | 2688 | -41 | 3507 | 1058 | -976 |
| $BIC$ | 29000 | 1731 | 5970 | 1537 | 692 | 1341 | 3962 | 2843 | 78 | 3641 | 1175 | -850 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 6: ESG and Firms Value - ESG Pillars - Before 2011

Dependent Variable = $Q_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ENV_{i,t-1}$ | -0.0244 | -0.1546 | 0.1653 | -0.0636 | -0.3452** | 0.2496 | -0.2536** | 0.1488** | -0.0122 | -0.3494 | 0.2816 | -0.0452 |
| $CGV_{i,t-1}$ | -0.002 | 0.0346 | -0.0195 | 0.0154 | -0.139 | 0.0621 | -0.0988 | -0.0351 | 0.0316 | 0.1743 | -0.12 | 0.0204 |
| $SOC_{i,t-1}$ | 0.0333 | 0.1261 | -0.0134 | 0.0625 | 0.1017 | -0.2328 | 0.3634** | -0.0708* | -0.0867* | -0.2395 | -0.0363 | 0.0565 |
| $CTR_{i,t-1}$ | -0.0012 | 0.0011 | -0.0502* | -0.0105 | -0.0079 | 0.0468 | 0.0221 | 0.0051 | -0.0205 | 0.049 | 0.0221 | 0.0059 |
| $SIZE_{i,t-1}$ | -0.5307*** | -0.0695 | -1.0977*** | -0.2328** | -0.2303** | -0.9696* | -0.2853 | -0.1825** | -0.2415** | -1.2513*** | -0.7764* | -0.2256*** |
| $ROA_{i,t-1}$ | 0.4472* | 0.5165 | -0.4653 | 0.8676** | -0.7946** | 2.0671 | 2.2546*** | -0.1096 | 1.8695 | 2.4446* | 2.0335** | 0.5427** |
| $SALES_{i,t-1}$ | -0.1188** | -0.2284 | -0.1076* | 0.0153 | -0.0087 | 0.6665 | -0.6309 | -0.0269 | -0.4356** | -1.4196** | -0.7659 | -0.2783*** |
| $LEV_{i,t-1}$ | -0.6107* | -0.4186 | 0.2986 | -0.1712 | -0.6174 | -6.0452*** | -0.5702 | -0.1931 | -0.4031 | -0.2554 | -0.1923 | -0.1858 |
| $CAPX_{i,t-1}$ | -0.447 | -2.7931 | -2.3194** | -3.0443* | -0.8977 | -5.8825 | -1.4076 | -0.2668 | -0.1577 | 5.1256 | 5.1635* | 0.3618 |
| $DIV_{i,t-1}$ | -1.5414** | -2.3749 | -2.0494 | -0.5206 | 1.4227 | 14.8447 | 1.6318 | 3.2834 | -1.9544 | -2.4198 | 0.4284 | -0.2295 |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 11.1041*** | 3.2104 | 20.6124*** | 5.8073*** | 7.2407*** | 18.9758* | 7.3084* | 4.6646*** | 5.6066*** | 25.3973*** | 15.0275* | 5.0193*** |
| $OBS$ | 5332 | 415 | 1006 | 474 | 313 | 109 | 491 | 1131 | 253 | 472 | 270 | 398 |
| $R^2$ | 0.1968 | 0.1509 | 0.2696 | 0.3225 | 0.482 | 0.5188 | 0.3359 | 0.2646 | 0.5354 | 0.3708 | 0.2787 | 0.4933 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 7: ESG and Firms Value - ESG Pillars - After 2011

Dependent Variable = $Q_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ENV_{i,t-1}$ | 0.0904 | 0.0618 | 0.0802 | -0.1987 | -0.1725 | 0.0913 | 1.1684*** | 0.0654 | 0.0781 | -0.3513 | -0.109 | -0.0131 |
| $CGV_{i,t-1}$ | -0.1436** | -0.0592 | -0.0848 | -0.1468 | -0.0442 | -0.0009 | -1.0788*** | -0.0443 | 0.086 | 0.1181 | -0.2713** | 0.0761* |
| $SOC_{i,t-1}$ | 0.2595*** | -0.1751 | 0.1473 | 0.3570* | -0.0352 | -0.0283 | 0.9436** | 0.0035 | -0.1336* | 0.7530** | -0.1012 | 0.1337** |
| $CTR_{i,t-1}$ | 0.0184** | 0.0161* | 0.0212 | 0.0558*** | 0.0108 | 0.0856* | 0.0803 | -0.0045 | -0.0061 | 0.047 | -0.0242* | 0.0164** |
| $SIZE_{i,t-1}$ | -0.3306*** | -0.3139** | -0.314 | -0.0932 | -0.3440*** | -0.3062* | -1.3179*** | -0.0424 | -0.0752 | -0.5993*** | -0.1192 | -0.0561 |
| $ROA_{i,t-1}$ | 2.1901*** | 1.4582*** | 2.3472*** | 1.4947* | 0.098 | 8.3044*** | 3.2763*** | 0.9263* | 1.5669 | 2.1121* | 1.1508** | 1.0692** |
| $SALES_{i,t-1}$ | 0.0853 | 0.0212 | -0.117 | -0.0017 | 0.0625 | -3.7522*** | -0.718 | 0.4641** | 0.3938* | 0.7517 | -0.3182 | 0.0807 |
| $LEV_{i,t-1}$ | 1.3284*** | -0.0886 | 1.1605* | 0.3244 | -0.9650* | 2.0611** | 3.2821** | 0.7074** | 0.7284 | 2.2645** | 1.2119*** | 0.0889 |
| $CAPX_{i,t-1}$ | 0.1395 | -0.1676 | -0.5765 | -0.8009 | 0.6392 | 13.8554 | 2.0402 | -1.1851 | 0.0244 | -0.3744 | 0.8516 | 0.2344 |
| $DIV_{i,t-1}$ | 2.0387* | 1.3110** | 0.4266 | 4.1633*** | 2.6941 | 7.0918 | 6.0045 | 2.6453** | -0.4031 | 0.2319 | 0.4342 | 0.5323*** |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 5.4761*** | 7.3827*** | 5.6588 | 2.6068 | 8.4530*** | 5.5402* | 18.1052*** | 1.4482 | 1.9799 | 8.3703** | 5.1853*** | 1.0298 |
| $OBS$ | 8712 | 691 | 1670 | 730 | 526 | 353 | 796 | 1729 | 470 | 800 | 376 | 571 |
| $R^2$ | 0.1522 | 0.2012 | 0.1692 | 0.241 | 0.2309 | 0.45 | 0.2723 | 0.2544 | 0.2691 | 0.3069 | 0.2101 | 0.3127 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 8: Investment Function - After 2011

Dependent Variable = $CAPX_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CAPX_{i,t-1}$ | 0.3823*** | 0.3292*** | 0.2591** | 0.4792*** | 0.4033*** | 0.2891*** | 0.3690*** | 0.5075*** | 0.1098* | 0.3336*** | 0.5498*** | 0.3781*** |
| $Q_{i,t-1}$ | 0.0022*** | 0.0206** | 0.0030*** | 0.0019 | 0.0122 | 0.0028*** | 0.0023*** | 0.0043*** | 0.0097* | -0.0002 | -0.0001 | 0.0026 |
| $LEV_{i,t-1}$ | -0.0173*** | -0.0091 | -0.0255*** | -0.0056 | -0.0732** | -0.0110** | -0.0001 | 0.0091 | -0.0144 | -0.0240*** | -0.0141 | -0.0162 |
| $CASH_{i,t-1}$ | 0.0071 | 0.0216 | 0.0104 | -0.0149 | 0.0193 | 0.0124 | -0.0132* | -0.0041 | 0.0346 | 0.0116 | 0.0117 | 0.003 |
| $SIZE_{i,t-1}$ | 0 | -0.0002 | 0.0001 | -0.0009 | -0.0124 | 0.0005 | 0.0002 | 0.0016 | -0.0298*** | 0.0009 | -0.0038 | 0.0036 |
| $RTRN_{i,t-1}$ | 0.0022** | -0.0025 | 0.0012 | 0.0037 | 0.0005 | -0.0008 | 0.0014 | 0.0022* | 0.0097 | 0.0035 | 0.0009 | -0.0024 |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | 0.028 | 0.0116 | 0.034 | 0.0363 | 0.2845** | -0.0076 | 0.0099 | -0.0194 | 0.5260*** | 0.0199 | 0.1033* | -0.0226 |
| $OBS$ | 9210 | 689 | 1647 | 704 | 518 | 901 | 854 | 1686 | 464 | 804 | 374 | 569 |
| $R^2$ | 0.2086 | 0.298 | 0.1309 | 0.3788 | 0.4876 | 0.2971 | 0.3041 | 0.2363 | 0.1588 | 0.1924 | 0.4973 | 0.2699 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 9: Overinvestment - Combined ESG Scores - After 2011

Dependent Variable = $OVIT_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $OVIT_{i,t-1}$ | 0.6577*** | 0.6270*** | 1.2087*** | 0.2223 | 0.9791*** | 2.7390*** | 0.6999*** | 0.3334** | 0.4173 | 0.4960** | -0.0502 | 1.1277*** |
| $COMB_{i,t-1}$ | 0.1311 | -0.6433** | 0.0151 | -0.1714 | -0.3467 | -0.4208** | 0.5119** | -0.0407 | -0.3102 | -0.2451 | -0.2974 | 0.7916** |
| $COMM_{t-1}$ | 2.4705 | 14.9859* | -2.5432 | 3.9666 | 15.2052 | 10.1317 | -16.5534** | -3.8219 | 16.5594 | -8.2286 | 3.5928 | 5.7071 |
| $WGDP_{t-1}$ | -0.094 | -0.0581 | -0.4106 | 0.1623 | 0.3055 | 0.0466 | -0.1109 | -0.1952 | 0.9764 | -0.0109 | -0.1422 | -0.061 |
| $HGDP_{t-1}$ | 0.0246 | 0.1665** | 0.0149 | -0.0439 | -0.0001 | -0.0436 | -0.0673 | -0.0015 | -0.084 | -0.0082 | -0.046 | 0.0795 |
| $GEPU_{t-1}$ | 0.2048 | 3.0404*** | 0.2829 | -1.1584 | -0.5098 | 1.651 | -2.0098 | -0.6981 | 2.6226 | -0.7349 | 0.4947 | 0.3724 |
| $WGI_{t-1}$ | 0.3215** | 0.0501 | 0.3519 | 0.2037 | 0.2067 | 0.2214 | -1.2844** | -0.1982 | 1.5297** | 0.1327 | 1.6106** | -0.6709 |
| $INFL_{t-1}$ | -0.0294 | 0.0477 | -0.0253 | -0.0723 | 0.0962 | 0.0629 | -0.0726 | -0.0365 | 0.084 | -0.1021 | -0.3551* | 0.097 |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | -1.6927 | -13.5780** | -0.6781 | 6.287 | 2.5449 | -8.3817 | 6.5114 | 3.531 | -13.8566 | 4.1283 | 2.3708 | -6.6631 |
| $OBS$ | 7742 | 561 | 1389 | 601 | 440 | 765 | 705 | 1443 | 385 | 651 | 312 | 490 |
| $R^2$ | 0.17 | 0.22 | 0.19 | 0.16 | 0.20 | 0.21 | 0.22 | 0.13 | 0.18 | 0.20 | 0.21 | 0.23 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.

Table 10: Overinvestment - ESG Pillars - After 2011

Dependent Variable = $OVIT_{i,t}$

| Variable | Full Sample | Basic Materials | Cons Discret | Cons Staple | Energy | Financials | Health Care | Industrials | Real Estate | Technology | Telecom | Utilities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $OVIT_{i,t-1}$ | 0.6490*** | 0.5982*** | 1.2425*** | 0.2026 | 0.9348*** | 2.6982*** | 0.6947*** | 0.3170* | 0.4571 | 0.5034** | -0.127 | 1.2379*** |
| $ENV_{i,t-1}$ | -0.1136 | -0.6032 | 0.2281 | -0.1869 | -0.3728 | -0.3120* | 0.2589 | -0.2449 | 0.1762 | -0.6058** | -2.0440* | -1.0922** |
| $CGV_{i,t-1}$ | 0.0542 | -0.2739 | 0.0489 | -0.1593 | 0.2622 | -0.1142 | -0.4299* | 0.0461 | -0.176 | -0.1865 | 0.4942 | 0.5459 |
| $SOC_{i,t-1}$ | 0.2623* | 0.5722 | -0.0015 | 0.1426 | -0.1261 | -0.0877 | 0.1534 | 0.169 | -0.0524 | 0.6361* | 2.1480** | 0.4461 |
| $CTR_{i,t-1}$ | 0.0257 | -0.1550** | -0.0392 | 0.0504 | -0.0726 | -0.0247 | 0.1964*** | -0.0067 | -0.0918 | -0.1045 | -0.2035 | 0.3094*** |
| $COMM_{t-1}$ | 2.5089 | 15.4284* | -2.8773 | 2.778 | 14.9945 | 8.9914 | -17.3181** | -3.8639 | 15.8424 | -7.4431 | 1.0188 | 4.4511 |
| $WGDP_{t-1}$ | -0.0941 | -0.0442 | -0.4548 | 0.1963 | 0.2915 | 0.0402 | -0.1221 | -0.192 | 0.9531 | 0.0359 | -0.164 | -0.0792 |
| $HGDP_{t-1}$ | 0.0243 | 0.1635** | 0.0171 | -0.0456 | 0.0026 | -0.0508 | -0.0788 | -0.0035 | -0.0715 | -0.0108 | -0.0488 | 0.0629 |
| $GEPU_{t-1}$ | 0.1875 | 2.9638** | 0.0098 | -1.0588 | -0.7706 | 1.6656 | -1.4749 | -0.6902 | 2.2079 | -0.6296 | -0.0119 | 0.6268 |
| $WGI_{t-1}$ | 0.3243** | 0.119 | 0.3611 | 0.2059 | 0.2403 | 0.215 | -1.2466** | -0.224 | 1.5616* | 0.164 | 1.9378* | -0.4578 |
| $INFL_{t-1}$ | -0.0304 | 0.0345 | -0.0231 | -0.0761 | 0.0924 | 0.0592 | -0.0693 | -0.0396 | 0.0803 | -0.1201 | -0.3991** | 0.0607 |
| $YRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $FRID$ | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $CONS$ | -2.0004 | -13.8989** | -0.1084 | 5.7028 | 3.8273 | -7.8766 | 5.2977 | 3.4548 | -12.372 | 3.5221 | 2.1708 | -5.0057 |
| $OBS$ | 7742 | 561 | 1389 | 601 | 440 | 765 | 705 | 1443 | 385 | 651 | 312 | 490 |
| $R^2$ | 0.17 | 0.23 | 0.19 | 0.16 | 0.20 | 0.21 | 0.23 | 0.13 | 0.18 | 0.21 | 0.24 | 0.26 |

*Note:* The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10% significance level.