The Effect of Sustainability Reporting on ESG Ratings

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Abstract

Over the past decade the concept of Environmental, Social, and Governance (ESG) investing has emerged to aid investors to maximize return on investments while simultaneously supporting environmentally and socially friendly methods of production and operation. In this paper I investigate the effect of the quality of sustainability reporting on ESG ratings. I utilize a sample of 100 chemical companies with ESG ratings and sustainability disclosure indexes over a 14-year time period (2007-2020) to analyze the short- and long run effects of sustainability reporting on ESG ratings. Using OLS my regression results suggest that better overall ESG disclosure as well as individual E, S, and G disclosure leads to worse ESG ratings in both the short run and the long run.

JEL classification: M14, M40

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I. Introduction

In this paper I investigate the impact short and long run effects of sustainability reporting on the ESG scores of major chemical producers in 28 different countries. Every year the Political Economy Research Institute releases rankings known as the Toxic 100, a list of the 100 companies whose operations have the greatest adverse environmental damage. Chemical producers are the most represented in the Toxic 100 which sets up the importance of this investigation. Throughout this study I will investigate the extent to which chemical producers' environmental, social, and governance impact is effectively communicated to stakeholders through ESG ratings and how these companies influence these ratings through sustainability reporting efforts.

As the threat of climate change has become increasingly immediate over the past years, the concept of Environmental, Social, and Governance (ESG) investing has emerged to aid investors to maximize return on investments while simultaneously supporting environmentally and socially friendly methods of production and operation. Around the globe, a third of all professionally managed assets (roughly $30 trillion) are now subject to ESG criteria. This sum represents an increase of more than 30% since 2016. Between April and June of 2020 alone, investors poured more than $70 billion into ESG equity funds, vastly exceeding historic annual flows. ESG investing only emerged over the past two decades and, despite a drastic rise in popularity in the past few years, the regulatory framework around it is still in its infancy.

ESG investing is meant to align the financial performance of a company and its impact on the environment and social problems. The compilation of ESG ratings is based on corporate reporting in which companies committed to ESG initiatives publish measurable goals and their progress against these goals in periodic sustainability reports as well as non-self-disclosed

information from public sources. ESG scores are compiled by third-party evaluations in which agencies like Morgan Stanley Capital International (MSCI), S&P Global, RobecoSAM, Sustainalytics, and RepRisk among others compile ESG ratings of public companies based on their performance in a variety of criteria. There are around 140 rating agencies, whereby the ones listed above are the most well-known. Ratings are compiled for public companies as the main purpose of ESG ratings is to reduce information asymmetry and communicate a public company's ESG impact to investors. The ESG ratings are independent to the agency that compiles the rating and may vary in terms of the underlying criteria as well as in the nominal ratings for different criteria. MSCI, for example, "evaluates 37 key ESG issues divided into three pillars (environmental, social, and governance) and ten themes (climate change, natural resources, pollution & waste, environmental opportunities, human capital, product liability, stakeholder opposition, social opportunities, corporate governance, and corporate behavior)." In contrast to this, Sustainalytics examines a range of 70 ESG indicators for each economic sector and breaks them down into "three distinct dimensions: preparedness, disclosure, and performance." The ISS E&S Quality Score evaluates more than 380 factors, with "at least 240 for each industry group, divided into environmental and social factors including management of environmental risks and opportunities, human rights, waste and toxicity, and product safety, quality, and brand." RepRisk on the other hand, – the database that will be used for this study – "intertwines ESG issues—including environment, community relations, employee relations, and corporate governance—with the Ten Principles of the UN Global Compact." RepRisk also measures ESG risk exposure using twenty-eight ESG issues and forty-five "hot topics." Some of the hot topics potentially relevant to the chemical sector are plastics, chemical weapons, fracking, greenhouse gas emissions, and health impact, among others. RepRisk does not specify

what metrics are used to evaluate a company's impact on a given hot topic or how each is weighted. This problem occurs with many rating agencies as they do not fully disclose their methods of rating compilations or the material criteria of selected indicators, likely as a result of overprotectiveness of their proprietary methodologies which helps perpetuate an overall lack of transparency over ESG ratings (El-Hage, 2020). These distinctive approaches may still provide useful broad signals to the investors, but they lead to highly variable results, thus undermining the quality of information the market is relying on when making sustainable investment decisions (El-Hage, 2020).

Currently public companies are required to publicize minimal indicators of their operations' impacts on environmental and social issues (Giudice, 2020). In 2019 the EU passed the Non-Financial Reporting Directive (NFRD), which applies to all companies with >500 employees (i.e. 6,000 companies across the EU). Companies are required to report on issues of environmental matters, social and employee aspects, respect for human rights, anti-corruption and bribery issues, and diversity on board of directors. Under the NFRD companies are given the freedom to disclose the information required by the NFRD in the way they find useful or in a separate report. Another widely used framework are the Sustainability Accounting Standards Board (SASB) materiality criteria. The SASB is a non-profit organization that was founded in 2011 to develop sustainability reporting standards. It has released guidelines for material ESG reporting for 77 different industries, which are often used in combination with the Global Reporting Initiative (GRI) Standards to fulfill the material reporting section of the reporting framework. The GRI was founded in 1997 by United States-based non-profits Coalition for Environmentally Responsible Economies and the Tellus Institute with the support of the United Nations Environment Programme and provides a framework known as the GRI Standards, which

is the most widely used framework for sustainability reporting, as 190 out of the world's 250 biggest companies apply it. Under the GRI standards companies are required to make five disclosures, which provide an overview of the organization, its sustainability reporting practices, and the entities covered; two disclosures, which cover the organization's activities, and its employees; fifteen disclosures, which provide an overview of the organization's governance structure; seven disclosures, which provide an overview of the organization's policies and practices for responsible business conduct; and two disclosures, which cover the organization's stakeholder engagement practices. In addition, the framework obligates companies to report on issues most relevant to their sector and their firm specifically and provides guidance on identifying these material ESG issues. This is where the SASB standards gain relevance as they are most widely consulted to identify and report on material ESG issues. The SASB states that "Use of SASB standards is voluntary. A company determines which standard(s) is relevant to the company, which disclosure topics are financially material to its business, and which associated metrics to report, taking relevant legal requirements into account." This makes comparability across different companies difficult. Furthermore, commonly applied frameworks like the SASB materiality guidelines and the GRI Standards often require a limited degree of detail. The largely qualitative nature of sustainability reporting makes the auditing process difficult and allows public companies a large degree of freedom in choosing the degree of detail and the specific metrics that are disclosed regarding sustainability issues. Dubbink et al. (2008) note that larger firms use more instruments to analyze and report ethical and sustainable behavior. They also assert that cost pressure between smaller firms is higher. The provision of sustainability data in itself is costly. In a study on Fortune 500 companies Hutton et al. (2001) found that

communication spending for social responsibility is the third-largest budget item for corporate communication departments.

The current voluntary regulatory environment has major limitations, as it provides incentives for companies to engage in various forms of greenwashing (Delmas, 2011). Evidence confirms that firms generally overstate beneficial private information to create an exaggerated positive public impression (Lueg, 2020; Laufer, 2003; Kim, 2015; Marquis, 2016). Over 95 percent of products surveyed by TerraChoice in 2008/2009 committed at least one of the TerraChoice "Seven Sins of Greenwashing. This can undermine confidence in sustainability reporting and in the reliability of ESG scores. As Doyle (2018) points out "rating agencies in other capital markets are much more closely aligned. Moody's and S&P's credit ratings have a very strong positive correlation (0.90)." In contrast to this Doyle's research shows that ESG rating agencies frequently diverge in their assessments of the same company. A comparison of MSCI's and Sustainalytics' ratings for companies in the S&P Global 1200 index, found "a weak correlation (0.32) between the two firms' ratings." This is because credit ratings, unlike ESG ratings, are based on comparable information, in the form of standardized financial disclosures (Doyle 2018). Similarly, Berg (2019) finds that "ESG ratings from different sources are aligned in only about 6 out of 10 cases, compared to creditworthiness ratings, which match 99% of the time. As a result of the regulatory freedom companies have a high degree of leeway to both exaggerate the positive impact of their ESG initiatives and obscure the environmental and social damage of their operations. An overview of the existing literature on the topic will reveal that ESG ratings and firm size are strongly correlated. It is thought that especially firms with greater slack resources (usually larger firms) have the ability to invest more resources into the reporting procedures on ESG data (Drempetic, 2019). Therefore, throughout this study I will investigate

the effects of sustainability reporting on ESG scores. I will review the existing literature on ESG ratings and sustainability reporting before establishing the theoretical framework and hypotheses for the study and outlining the methodologies and results of this work.

II. Literature Review

ESG Literature

There are numerous studies investigating the relationship between ESG and corporate financial performance. There is widespread agreement throughout existing literature that ESG and corporate financial performance are positively correlated. Fulton et al. (2012) look at 50 papers and 4 meta studies and report that all investigated studies demonstrate that companies with higher ESG ratings or CSR scores face lower costs of capital for both debt and equity. Furthermore, 89% of the analyzed studies show companies with strong ESG ratings "exhibit market-based outperformance" and 85% of studies show these companies "exhibit accounting-based outperformance". In another meta-analysis Giese et al. find that higher ESG ratings are directly linked to increased gross profitability and trailing dividend yield. Furthermore, Giese's findings indicate that "ESG ratings affect the valuation and performance of companies, both through their systematic risk profile (lower costs of capital and higher valuations) and their idiosyncratic risk profile (higher profitability and lower exposures to tail risk)." Naffa and Fain (2020) find that investors do not sacrifice returns by aligning themselves with ESG considerations. They compile hypothetical ESG based investment portfolios and demonstrate that, even when accounting for transaction costs, the majority yield "non-negative excess returns" compared to passive benchmarks. Barth et al. (2016) find that ESG scores are positively

correlated with market performance as measured by a TQ model and Margolis et al. (2007) find a "significant positive correlation between ESG and financial performance."

There is little literature into what factors effect ESG ratings. El-Hage stipulates that this problem occurs because ESG rating agencies are overprotective of their proprietary methodologies and thus do not fully disclose their methods of rating compilations. This perpetuates an overall lack of transparency over ESG ratings (El-Hage, 2020). Drempetic et al. conducted a relevant study in 2019 in which they investigated the effect of firm size as measured by revenue, market capitalization, number of employees, and total assets on ESG ratings and found all around positive correlations between ESG ratings and all proxies of size in. This study focused on short term effects by applying a one-year time lag between a firm's size and its ESG rating in the following year. Other works have found that larger companies disclose more CSR relevant information (Adams et al. 1998), use more instruments to analyze, report, and audit CSR information (Graafland et al. 2003), and that communication spending for social responsibility is the third-largest budget item of communication departments of Fortune 500 companies (Hutton et al. 2001). These studies establish a link between firm size and reporting although they leave a gap in the literature as, to the best of my knowledge, the direct effect of sustainability reporting on ESG ratings has not been investigated. Furthermore, the existing studies on firm size and ESG ratings are focused on short-term correlations. We will thus further contribute to the literature by investigating a short and long run time horizon, the methodology for which is detailed in section V. Before we investigate the direct effect of ESG reporting and communication efforts on ESG ratings we will review the existing literature relevant to sustainability reporting.

Sustainability Reporting Literature

Firms are gradually adopting stricter and more consistent sustainability practices. Whetman (2017) finds a significant positive correlation between sustainability reporting and public companies' short-term profitability. Nzekwe et al. (2021) carried out a study to determine the effect of sustainability reporting on financial performance of quoted industrial goods companies in Nigeria. The study showed significant positive effect of sustainability reporting on financial performance of firms in Nigeria. El-Kassar & Singh (2019) find that green innovation reporting and sustainable development models can create an impact on the firm triple bottom line and give firms a competitive edge. Buallay et al. (2019) investigated the effect of sustainability reporting quality as measured by the Bloomberg ESG disclosure indices on various indicators of operational performance. They demonstrate that ESG disclosure positively affects market performance, as measured by a TQ model, but that it negatively affects current financial and operational performance, as indexed by return-on-assets and return-on-equity.

Schreck and Raithel (2015) and Verrecchia (2001) assert that sustainability reporting is a non-trust system and that non-availability of information will be interpreted as "bad news." The punishment for lacking sustainability reporting efforts is backed by Hughey and Sulkoski (2012) who observe that CSR reputation is higher when there are more available data points for a sample of companies in the oil and gas energy sector. They also find that increased size and age of a company drives the availability of data. In a separate study, Gangi and D'Angelo (2016) demonstrate that corporate sustainability performance drives ESG information disclosure and that ESG information disclosure drives the corporate sustainability performance in a reciprocal cycle. The idea that sustainability reporting is a non-trust system is backed by Giudice et al.

(2020). After studying the change in ESG scores following ESG related scandals of public companies they found that firms whose sustainability reports are audited by third parties did not exhibit significant changes in their scores after a scandal, whereas for companies whose reports are not audited, experienced a worsening of the ESG scores that are statistically significant. This study is closely related to my work as it indicates that ESG auditing – a component of ESG reporting – leads to more stable ESG scores, albeit not necessarily higher ones. This backs previous works that have demonstrated that third-party assurance about the quality of management's reporting has the potential to increase the credibility of voluntary disclosures (Healy, 2001). Furthermore, Capelle-Blancard and Petit (2017) found that "positive ESG news, which includes green-washing, reduces the financial penalties of the market from negative ESG news." In other words, a good ESG reputation not only boosts financial performance, it also protects against risks stemming from negative news. Graafland et al. (2003) finds that "SMEs that only halfheartedly implement CSR are more vulnerable to public criticism than SMEs that do not engage in CSR at all and that it is advisable that SMEs only position themselves as sustainable companies if their environmental policies have proven to contribute to sustainable development."

Another important aspect to consider within the existing literature are causal relationships of other external factors that may influence ESG scores. The effect of firm size on ESG ratings was investigated by Drempetic et al. (2019) who assert that "current ESG scores do not realistically measure the sustainability performance of a company: They depend on firm size, which mainly determines the data availability and resources for providing ESG data." This is supported by a study by Schadewitz and Niskala (2010) which concludes that "communication via Global Reporting Initiative (GRI) standard is an important explanatory factor for a firm's

market value". The work of Chauhan (2014) indicates that CSR reporting expenditure grows with firm size, demonstrating that firms themselves invest more resources into sustainability reporting beyond regulatory requirements in order to gain a competitive advantage. The works of Hahn and Kühnen (2013) verify that the size of a given firm is the main internal determinant that consistently and positively affects sustainability reporting quality and quantity. Finally, Gallo and Christensen (2011) found that the production of increasingly complex and multi-faceted sustainability reports increases with the size of the company. King and Bartels (2015) stipulate that information is critical in evaluating the sustainability of a company. The demand for transparency is comprehensible and as such companies are increasingly publishing voluntary sustainability reports that go beyond regulatory requirements. Whether the practice of improved sustainability reporting has a direct effect on ESG ratings, however is not well established in the existing literature. Past works are limited to investigating the impact of firm size on ESG ratings. This investigation will contribute to closing a gap in the literature as we will attempt to answer the question of whether better sustainability reporting leads to better or worse ESG ratings.

III. Theoretical Framework

The main purpose of sustainable finance and the implementation of ESG scores in investment evaluations is intergenerational justice (Soppe, 2004). By channeling increased capital to sustainable firms, the generation of ESG scores tangibly supports international commitments like the Sustainable Development Goals and the Paris Climate Accord. Two similar theories underlie the growing popularity and importance of ESG investing. The first is neo-institutional theory which asserts that "in the approach of organizational legitimacy, the survival of a company depends on their acceptance by society (DiMaggio and Powell 1983; Meyer and Rowan 1977)".

In the scope of neo-institutional theory, ESG rating agencies assess the legitimacy of a given company through the ratings they provide. ESG conscious investors pay rating agencies for ESG ratings to reduce the presence of information asymmetry (Cho et al. 2013; Cui et al. 2016). ESG indicators are then used in combination with financial criteria to reach investment decisions.

Stakeholder theory as discussed by Freeman (1984) and Porter & Kramer (2006) stipulates that rather than being a cost or charitable deed, CSR initiatives generate opportunity, innovation, and competitive advantage for firms, while simultaneously offering solutions to pressing social issues. The essence of the idea behind stakeholder theory is similar to neo-institutionalism as it states that maximizing stakeholder value will ultimately maximize shareholder value. The vast majority of research on the effect of CSR and ESG performance on firm value supports stakeholder theory. Bannier et al. (2020) find that firms with higher ESG scores display lower measures of risk on both the equity and debt side, and that they realize a higher firm value after a 1–4 year time lag. The majority of the papers outlined in the literature review all support the validity of stakeholder theory.

Friedman (1970) and Jensen (2001) are strong proponents of a contrasting theoretical framework, which states that the firm's responsibility is to maximize profits and shareholder value. Shareholder theory states that CSR actions with the intent of benefitting external stakeholders come at a cost to shareholder value. CSR initiatives are thus seen as wealth transfers with detriment to shareholders. Under the theory firms have no duty to appease any other stakeholders in society other than shareholders and are solely accountable to maximize shareholder value. Few studies conducted on this theory find supporting evidence for shareholder theory. Krueger (2014) finds that firms that do not have a history of exceptionally poor CSR experience a negative investor response to both positive and negative CSR events. The results of

a study by Cellier and Chollet (2016) is even less supportive of shareholder theory as it finds that only few specific CSR factors (e.g. community involvement) are value destroying while others (e.g. human rights considerations at the workplace) are value enhancing. Buallay et al. (2019) find mixed results as on the one hand an increased focus on ESG disclosure was negatively correlated with short term operational performance, thus supporting the cost-of-capital reductionist stance of Friedman (1970) and Jensen (2001). On the other hand, prioritizing ESG disclosure led to long term market outperformance in their TQ Model regression, thus supporting the value creation perspective put forth by Freeman (1984) and Porter & Kramer (2006).

Based on the existing literature review and the established theoretical framework I have formulated the following hypotheses for both short and long-term effects of ESG disclosure on ESG ratings. The distinction in time effects is one that is lacking in previous investigations on the effect of firm size on ESG ratings and will hopefully aid us in better understanding any potential relationships between ESG disclosure and ESG ratings.

Short-term Hypotheses

In the short run I expect that I higher overall ESG disclosure score will lead to a lower ESG rating. When Buallay et al. (2019) investigated the effect of sustainability reporting quality as measured by the Bloomberg ESG disclosure indices on various indicators of operational performance they demonstrate that although ESG disclosure positively affects market performance, it negatively affects current financial and operational performance, as indexed by return-on-assets and return-on-equity. This finding is backed by shareholder theory which asserts CSR actions with the intent of benefitting external stakeholders come at a cost to shareholder value. As we know from the work of Hutton et al. (2001) communication spending for social

responsibility is the third-largest budget item for corporate communication departments. It is thus fair to assume that investment in ESG disclosure may bring about an opportunity cost that limits the actual ESG policies instated by companies. Individual E and S disclosure are also hypothesized to bring about a negative short-term effect on ESG scores as environmental and social issues usually require longer term attention and efforts to address. Good E and S disclosure is likely only to benefit a company's ESG score once the company has had the chance to implement ESG policies and actions to improve the environmental and social impact of their operations. Individual G disclosure is predicted to have a positive short-term effect on ESG scores as it generally does not represent a high cost to fully and legitimately disclose a company's governance structure.

Long-term Hypotheses

In the long run I expect that overall ESG disclosure as well as individual E, S, and G disclosure will lead to improved ESG ratings. This is partly because there may be a reverse effect in that a company that is more invested in optimizing their ESG performance has a greater incentive to be transparent about these efforts to improve their ESG rating. Given the work of Giudice et al. (2020) and the widespread agreement throughout the existing literature on the causal impact of ESG scores on financial performance, firms obviously have an incentive to boost their ESG ratings. Throughout the regression we will control for this reverse effect by integrating greenhouse gas intensity as a control, which is the most significant indicator of chemical companies' ESG efforts (SASB, 2020). The other rationale for better disclosure leading to better ESG scores in the long run is that high quality ESG reporting demonstrates awareness of ESG issues and signals intent to tackle these issues. Over the long run firms have the time to address

the environmental, social, and governance impacts of their operations and the more familiarized they are with the nuanced impacts on these factors (i.e., the better they report on them), the more likely they will be willing and able to address these issues.

IV. Data

Independent & Dependent Variable Data Overview

The dependent variable in this study - ESG scores and risk assessments – are provided by the RepRisk database. This data has not been used to investigate the effect of sustainability reporting on ESG scores, to the best of my knowledge. RepRisk defines its goal to "systematically identify and assess material ESG risks." RepRisk focuses on capturing and analyzing ESG information that may have a financial, reputation, or compliance impact on a company to give accurate ESG risk assessments. RepRisk employs an outside-in approach by exclusively analyzing information from public sources and stakeholders while disregarding company self-disclosures. Data is collected, aggregated, and analyzed from over 100,000 media, stakeholder, and other third-party sources and a combination of artificial intelligence (AI), machine learning, and human intelligence is employed to thoroughly analyze available information and to identify and assess material ESG risks.

The RepRisk database offers a RepRisk Rating (RRR) and a RepRisk Index (RRI). RRR integrates the ESG risk exposure of the firm's country and economic sector of operation with the company's own ESG risk exposure to provide a letter rating (AAA to D) which facilitates benchmarking and ESG performance comparisons across firms. For the purpose of this work I will assign numerical values to the firms' ESG scores whereby the highest rating (AAA) equals 1, the next highest (AA) equals to 2, and so on. The RRI is a quantitative measure of a firm's reputational ESG risk exposure. The scale goes from 0 to 100, whereby a 0 signifies that a firm

has not had any ESG related exposure in the past two years. The RRI is different from the RRR in that it focuses exclusively on reputational ESG risk exposure. All ESG ratings are updated on a biweekly basis although most observable variation occurs over longer time horizons. Due to the flexibility of ESG ratings it is reasonable to assume that there will be an observable short run effect. The short update interval indicates that rating agencies generally adapt ESG ratings quickly in response to important events or releases regarding a company's ESG performance. For the purpose of this investigation, I retrieved annual ESG ratings from the last day (12/31) of each year.

The independent variables in this study – the indicator that will be used for the quality of ESG disclosure – is provided by the Bloomberg database. This data has been used to investigate the effect of sustainability reporting on operational and financial performance. Under the scope of this investigation, we aim to establish to what extent the quality and quantity of ESG reporting affects a firm's ESG scores. "Bloomberg captures ESG data from company reports, AGM results, sustainability related press releases, policy documents, and websites and any other publicly available documents" to ensure that the content of self-reported ESG information aligns with the standardization of regulation. Bloomberg's goal is to clean and standardize inconsistent company reporting to the highest standard to provide a holistic picture of a company's environmental and social performance. The Bloomberg disclosure index is used to numerically index the quality and compliance of companies' self-reported data. The scale goes from 0 to 100, where 100 is the highest achievable level of sustainability reporting. The database provides a comprehensive index for a company's overall ESG disclosure efforts as well as individual indices to evaluate firms' disclosure standards in the individual categories of environmental, social, and governance. Under the scope of this work, I will examine the effect of corporate

sustainability disclosure as measured by the Bloomberg ESG Disclosure Index on ESG scores of chemical producers as measured by the RepRisk RRR index. The contribution of this approach is twofold. Firstly, given the widely established link between ESG scores and financial performance within existing literature, a relationship between sustainability disclosure and ESG ratings may contribute to the literature on the effects of sustainability reporting and financial performance. Secondly, an entirely new contribution is made by investigating the link between the Bloomberg Disclosure Index (based on self-reported ESG information) and the RepRisk RRR index (based on non-self-reported ESG information).

Table 1 summarizes the previously detailed predicted effects, whereby I expect that higher disclosure scores for ESG, E, and S will lead to lower ESG ratings in the short term but allow companies to achieve higher ESG ratings in the long run.

Table 1: *Predicted SR and LR Effects of Independent & Dependent variables*

Variable	Variable Type	Range of Values	Definition	Predicted SR Effects	Predicted LR Effects
ESG Disclosure	Ordinal Number	0-100	Company's ESG disclosure rating at end of year	(-) Higher ESG disclosure leads to lower rating	(+) Higher ESG disclosure leads to higher rating
E Disclosure			Company's ESG disclosure rating at end of year	(-) Higher E disclosure leads to lower rating	(+) Higher E disclosure leads to higher rating
S Disclosure			Company's ESG disclosure rating at end of year	(-) Higher S disclosure leads to lower rating	(+) Higher S disclosure leads to higher rating
G Disclosure			Company's ESG disclosure	(+) Higher G disclosure	(+) Higher G disclosure

			rating at end of year	leads to higher rating	leads to higher rating

Control Variable Data Overview

The control variables are determined from the existing literature. As mentioned previously one of the most strongly correlated variables with ESG ratings is the size of the firm. As the work of Drempetic et al. (2019) concluded "ESG scores do not realistically measure the sustainability performance of a company" but rather "they depend on firm size, which mainly determines the data availability and resources for providing ESG data." As discussed in the literature review this work is widely supported by other studies that demonstrate that larger companies invest relatively more into sustainability reporting and that demonstrate a positive relationship between sustainability reporting efforts and financial performance. In order to control for the effect of firm size I will integrate annual revenue in current US$ as a proxy for size. Another influence that I will control for in the regression model is the material environmental impact. According to the SASB materiality standards for the chemical industry, fuel economy and use-phase emissions are a highly material criteria in the generation of ESG scores. ESG rating agencies do not fully disclose their methodologies or the material impact of selected indicators, likely as a result of overprotectiveness of their proprietary methodologies (Giudice, 2020). Therefore, to control for the direct effect of environmental performance we will include greenhouse gas intensity (greenhouse gas emission / total assets) in the regression. Lastly, I will control for the overall economic influence on ESG scores by integrating the GDP per capita of the country of operations of each investigated firm. Even though there are few works to support the relationship between a country's GDP and national ESG scores the Environmental Kuznets Curve Hypothesis

(EKC) offers a theoretical foundation to control for this variable. The EKC contends a U-shaped relationship between economic growth and its environmental impacts (Kuznet, 1955). Thereby an emerging economy sacrifices greater parts of its natural environment in order to achieve faster economic growth before reaching a tipping point at which environmental damages are reduced while the economy continues to grow. Based on this hypothesis less developed economies are likely to have less stringent sustainability regulations which could skew ESG ratings of national firms downward. GDP per capita figures are obtained from the Knoema World Bank Database and are given in current US dollars. The control variables and their expected relationships with short and long run ESG ratings are outlined in table 2 below.

Table 2: *Predicted Control Variable Relationship*

Variable	Variable Type	Definition	Predicted SR Relationship	Predicted LR Relationship
Revenue	Ordinal Number	Company's Revenue in millions of U.S. dollars at end of financial year	(+) Higher revenue leads to higher ESG rating	(+) Higher revenue leads to higher ESG rating
GDP p.c.		Average income of people in company's home country	(+) Higher gdp p.c. leads to higher ESG rating	(+) Higher gpd p.c. leads to higher ESG rating
GHG Intensity		Ratio of millions of tonnes of greenhouse gases to U.S. dollar value of assets	(-) Higher ghg intensity leads to lower ESG rating	(-) Higher ghg intensity leads to lower ESG rating

Data Cleaning

Throughout this investigation I drew data from three separate databases. These are detailed in Table 3 below. The Bloomberg database was used to obtain ESG disclosure indexes, individual E, S, and G disclosure indexes, annual revenue, and annual greenhouse gas intensity. It also provided a list of 223 public chemical producers for which I attempted to collect annual data for each of the mentioned six variables. The data obtained for these variables varied in completion. All six of the variables obtained from Bloomberg varied in completion. Importantly, disclosure indexes were first compiled for different companies in varying years meaning that the years in which the disclosure indexes were not available were dropped from the observation time span for specific companies. A further limitation is that, due to lacking regulation, the reporting of GHG intensity also begins at varied time periods. Again, any annual observation that lacked the GHG intensity value was dropped for that specific company. Revenue figures were largely complete with only a few insignificant gaps in the data. These coincided with observations where ESG disclosure indexes or GHG intensity figures were lacking anyway, so no further observations were dropped. The RepRisk database was accessed through Wharton Research Data Services and provided annual ESG ratings from 2007-2020 for 100 of the 223 chemical producers listed on Bloomberg. This determined the final sample size of 100 chemical companies. Among the firms for which ESG ratings were available there were no gaps in the data from year to year.

Table 3: *Data source overview*

Data	Source	Sample	Notes on Completeness
ESG (E, S, G) Disclosure Indexes	Bloomberg Terminal	-Annual indexes for 223 chemical producers from 2007-2020	-Varying completeness, ESG disclosure indexes were instated later than 2007 -Time span varies for the sample of companies as the years without a disclosure index were dropped for specific companies
ESG Ratings	Wharton Research Data Services	-Annual ESG Ratings for 100 chemical producers from 2007-2020 -1400 observations	-The sample of 223 chemical producers was cut to 100 based on the limited number of companies for which ESG ratings were available
Revenue	Bloomberg Terminal	-Annual revenue for 223 chemical producers from 2007-2020	-Largely complete -Individual gaps in data (<10 / 3122 observations) were discarded
GHG Intensity	Bloomberg Terminal	-Annual GHG intensity for 223 chemical producers from 2007-2020	-Varying completeness as some companies started reporting GHG intensity later than others -Years without a GHG intensity measure were dropped for specific companies
GDP	Knoema Database	-GDP per capita figures for 28 countries of operations for chemical producers -1400 observations	-Fully complete

Table 4 below displays the descriptive statistics for the variables applied in the multivariate regression.

Table 4: *Independent and Control Descriptive Statistics*

Variable	Observations	Mean	Median	Std. Dev.	Min	Max	Skewness
ESG Rating (Index)	943	9.39	10	1.81	1	12	-0.96
ESG Disclosure	943	44.75	44.21	11.98	16.53	73.55	-0.07
E Disclosure	943	40.49	40.31	15.36	4.65	77.52	-0.10
S Disclosure	943	42.09	42.11	14.67	3.51	80.70	0.06
G Disclosure	943	57.43	57.14	10.36	14.29	80.36	-0.57
GHG Intensity (Mtonnes/$)	943	273.05	116.2	379.90	0.04	2347.98	2.15
GDP p.c. ($)	943	41,817.98	44,968.16	21576.15	908.10	117,197.50	-0.21
Revenue (M$)	943	8,873.19	5082.00	12,529.94	79.98	74,326.00	2.91

The descriptive statistics show that the average ESG rating for our sample of chemical producers is a 9.39 on the established 12 point scale i.e., the equivalent of a BBB whereas the median of 10 is equivalent to an A rating. The means and medians of overall ESG disclosure and individual E and S disclosure fall in the same range. This is to be expected given the high correlation between these three indicators (see Table 5). The average and median G disclosure score however are around 33% higher. This is expected because governance issues are usually less multi-faceted and less qualitative in nature than environmental and social issues and thus easier to report on. After determining the descriptive statistics no further data manipulation was made. One of the

features that jumps out however is that the GHG intensity and revenue data are significantly right skewed. As seen in the table above the skewness for both these variables demonstrate a skewness of 2.15 and 2.91, respectively. In order to normalize this effect, I will additionally run the multivariate regression with the natural logarithm of the GHG intensity and revenue data. Figures 4 displays a general correlation matrix to gain an idea for correlation strengths and potential issues of multicollinearity.

Table 5: *Same Year ESG Correlation Matrix*

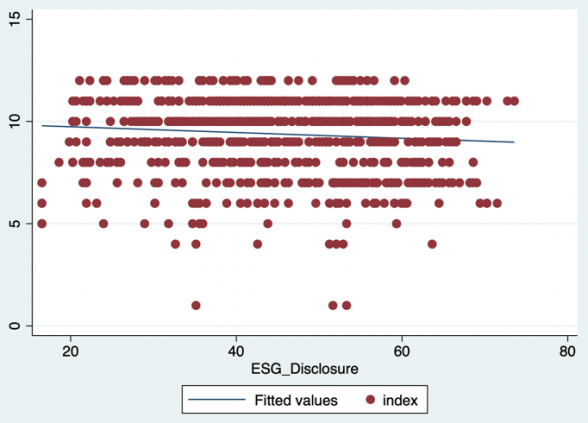
	ESG index	ESG disc.	E disc.	S disc.	G disc.	Rev.	GDP	GHG Int.
ESG index	1.000							
ESG disc.	-0.0938	1.000						
E disc.	-0.113	0.945	1.000					
S disc.	-0.0743	0.799	0.6257	1.000				
G disc.	-0.0063	0.584	0.391	0.400	1.000			
Rev.	-0.325	0.178	0.182	0.107	0.114	1.000		
GDP	0.485	0.161	0.128	0.0676	0.238	-0.135	1.000	
GHG Int.	0.132	0.108	0.0615	0.0709	0.218	0.0920	0.279	1.000

As one would expect, the matrix demonstrates that the independent variables of ESG disclosure and individual E, S, and G disclosure are relatively strongly correlated. For this reason, I will run the multivariate regressions with only one independent variable at a time in order to avoid multicollinearity issues. In accordance with the established short run hypotheses, we find that ESG, E, and S disclosure are negatively correlated with the ESG rating. Furthermore, as the existing literature indicates both revenue and GDP are positively correlated with all disclosure variables. This supports slack resource theory and the works of Drempetic (2019) and Doyle (2018) which assert that bigger firms are able and willing to invest in better sustainability reporting. The only unexpected correlations we find is that revenue seems to be negatively correlated with ESG rating, contrary to the existing literature and that greenhouse gas intensity seems to be positively correlated with ESG ratings. In the next section I will focus on the univariate correlations that the initial data reveals. For this analysis I will look at the relationship between each predictor variable and ESG rating to get a sense of which disclosure aspects impact ESG ratings the greatest.

Univariate Exploratory Data Analysis

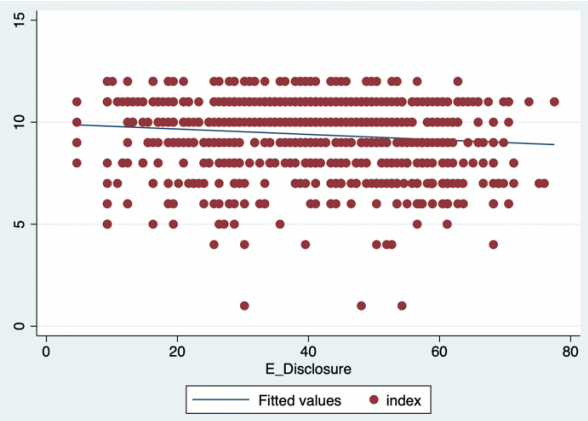
This section contains simple scatter plots for my continuous predictor variables with the constructed ESG rating index as the response variable. The initial univariate analysis will focus on the short run predictions by comparing ESG disclosure indexes with ESG ratings from the same year. After that I will provide an overview of the long-term univariate analysis, whereby I will correlate the ESG ratings with the ESG disclosure indexes from three years prior.

Figure 1: *Relationship between ESG rating index and ESG disclosure index (SR)*



In the initial univariate analysis ESG disclosure, the main predictor variable, appears to be loosely correlated to ESG ratings, whereby the analysis shows a slight negative correlation. Although the correlation is not particularly strong, this result matches the hypothesis I formulated in that a higher ESG disclosure appears to lead to a lower ESG rating within the same year i.e. in the short run.

Figure 2: *Relationship between ESG rating index and E disclosure index (SR)*



Both the univariate regressions with individual E and S disclosure also demonstrate a negative correlation, albeit slightly stronger ones. This is also in accordance with the formulated hypothesis.

Figure 3: *Relationship between ESG rating index and S disclosure index (SR)*

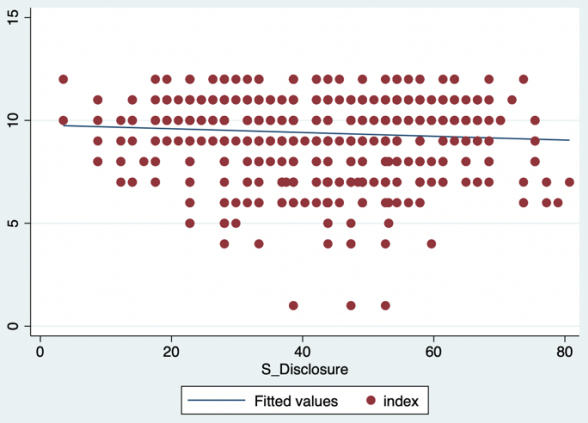
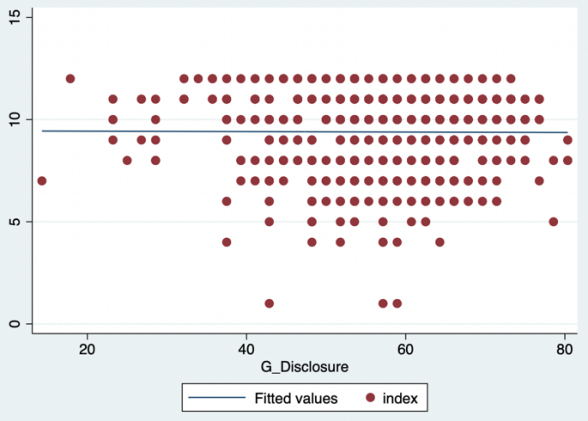


Figure 4: *Relationship between ESG rating index and G disclosure index (SR)*



The scatter plot for the univariate regression between ESG rating index and individual G is near flat, showing a very insignificant negative correlation. As expected by my short-term hypotheses this correlation is less negative than the correlations with individual E and S disclosure, however the predicted positive relationship between G disclosure and ESG ratings is not apparent in this initial univariate analysis.The following figures investigate the correlations between long-term ESG ratings and ESG disclosure indexes from a univariate perspective.

Figure 5: *Relationship between ESG rating index and ESG disclosure index (LR)*

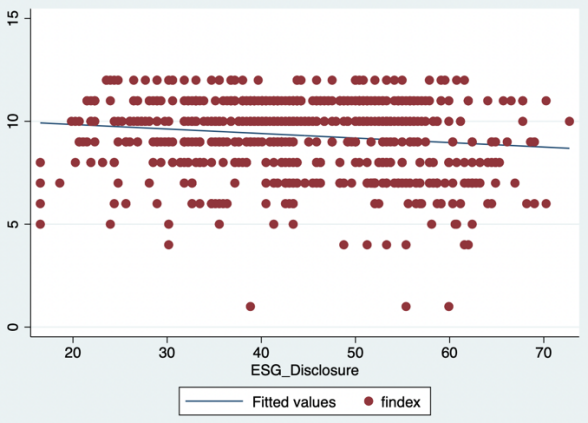


Figure 6: *Relationship between ESG rating index and E disclosure index (LR)*

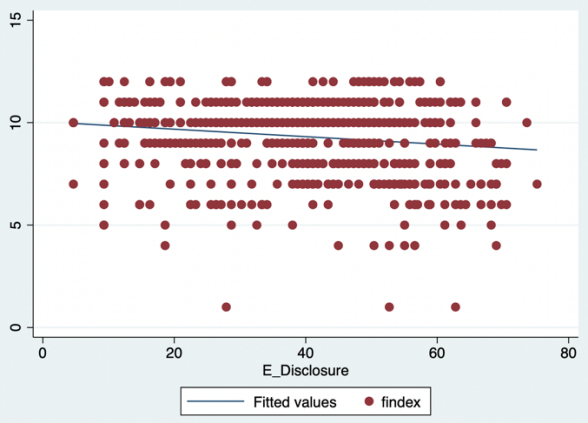


Figure 7: *Relationship between ESG rating index and S disclosure index (LR)*

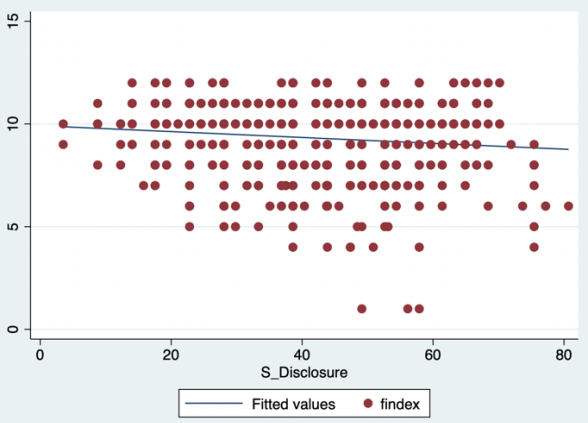
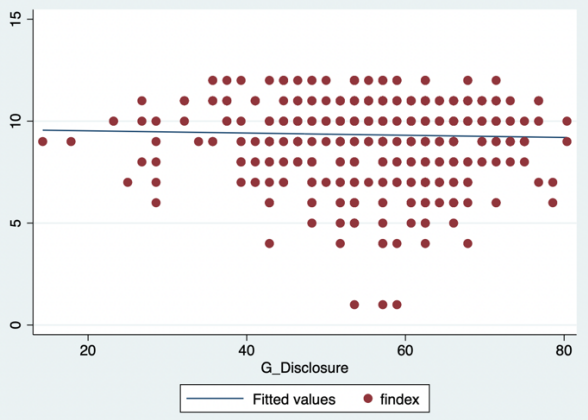


Figure 8: *Relationship between ESG rating index and G disclosure index (LR)*



The univariate regressions with the three-year time lag all display similar correlations as the ones without. This implies that even in the long run, better ESG disclosure is negatively correlated with ESG ratings, which goes against the hypothesized effects. To test the validity of this indication I integrate the independent and dependent variables with the aforementioned control variables in the below multivariate regression.

V. Empirical Results & Methodology

My multivariate analysis is also divided into short and long-run analysis. In the short-run, I investigate the impact of ESG disclosure and individual E, S, and G disclosure on the ESG rating in the same year, while controlling for each firm's size, environmental impact, and their country's GDP per capita. The general OLS short-run regression equation is shown below:

$$ESG\ rating = \beta_0 + \beta_1 ESGdisclosure + \beta_2 Revenue +$$

$$\beta 3\ GHG\ Intensity + \beta 4\ GDP + \varepsilon$$

I regress the ESG rating of the company against four linear combinations of the available ESG disclosure variables. These four combinations look at ESG disclosure from an overall and individual component level. Due to the high correlation between the four disclosure

indexes, I only regress one of them at a time against ESG ratings to avoid issues of multicollinearity. I run each regression three times: without controlling for fixed effects, controlling for fixed time effects, and controlling for both fixed time and company effects. Fixed time effects control for any variation that may occur as a trend over time due to unmeasured variables. For example, it is possible that regulatory requirements for ESG disclosure changed over time and thus led to general trends of improvement in disclosure indexes. Integrating fixed effects eliminate unmeasured variation due to company specific effects. In this case it may be the case that regulation to chemical producers may have caused the observed companies to adapt their disclosure practices thus impacting their ESG disclosure indexes. All regressions with and without fixed effect controls are also rerun using a log transformation for the revenue and GHG intensity data in order to control for the skewness found in the data for these two variables. All non-linear regressions are also each run without fixed effects, with fixed time effects, and with both fixed time and company effects. The findings of these regressions are summarized in the figures below. All regressions are run to allow for robust standard errors using the Stata command "vce(robust)". All regressions are summarized in Table 6, below.

Table 6: *Regressions*

Number	Regression
1	ESG rating = β_0 + β_1ESGdisclosure + β_2Revenue + β3 GHG Intensity + β4 GDP + ε **ESG Disclosure**
2	ESG rating = β_0 + β_1Edisclosure + β_2Revenue + β3 GHG Intensity + β4 GDP + ε **E Disclosure**

3	ESG rating = β_0 + β_1Sdisclosure + β_2Revenue + β3 GHG Intensity + β4 GDP + ε **S Disclosure**
4	ESG rating = β_0 + β_1Gdisclosure + β_2Revenue + β3 GHG Intensity + β4 GDP + ε **G Disclosure**
5	ESG rating = β_0 + β_1ESGdisclosure + $\beta_2$log(revenue) + β3log(GHG Intensity)+ β4 GDP + ε **ESG Disclosure**
6	ESG rating = β_0 + β_1Edisclosure + $\beta_2$log(revenue) + β3log(GHG Intensity)+ β4 GDP + ε **E Disclosure**
7	ESG rating = β_0 + β_1Sdisclosure + $\beta_2$log(revenue) + β3log(GHG Intensity)+ β4 GDP + ε **S Disclosure**
8	ESG rating = β_0 + β_1Gdisclosure + $\beta_2$log(revenue) + β3log(GHG Intensity)+ β4 GDP + ε **G Disclosure**

All of the above regressions were run for short and long run ESG ratings as well as without fixed effects, with fixed time effects, and with both fixed time and company effects, resulting in 24 different regressions being run, the results of which are summarized in the appendices section (pg. 48)

Short Run Findings

For the short run analysis, the ESG rating on the left-hand side of the equation and the disclosure index on the right-hand side were obtained from the same year. Overall, ESG disclosure and its individual components are significant determinants of ESG ratings. This is shown throughout all eight of the regressions run. As hypothesized ESG disclosure seems to have a negative effect on

ESG ratings in the short run. Individual E and S disclosure also have a statistically significant negative relationship with short run ESG ratings in both the linear models as well as the logarithmically transformed ones, which is in accordance with our established hypotheses. Given that the works of Hutton et al. (2003) identified communication spending for sustainability reporting as the third largest expenditure in Fortune 500 companies and Buallay et al. (2019) observed negative short run impacts on financial performance in firms with higher ESG disclosure, it is to be expected that better ESG disclosure may come with an opportunity cost for E and S policies. This is reflected in the results. Individual G disclosure also exhibits a statistically significant negative relationship with short run ESG ratings. This is unexpected as governance information is usually less costly to record and audit and governance issues do not typically take as long to resolve. Two more clear trends emerge from the regression work in the two models, those being a highly statistically significant positive relationship between GDP and ESG ratings in the short and a statistically significant negative relationship between revenue and short run ESG ratings. The former trend is in accordance with the established theory as, on the basis of the Kuznets Curve Hypothesis, we would expect more developed economies to have more stringent sustainability regulations thus leading to higher ESG ratings for companies in economies with higher GDP. The latter trend is surprising and goes against the findings of Drempetic et al. (2019) and Doyle (2018) who find that firm size as approximated by revenue is strongly positively correlated with ESG ratings. A possible explanation for this is the intrinsically environmentally harmful nature of the economic sector we are looking at combined with the reputational nature with which the RepRisk ratings are established. Seeing as RepRisk only uses external sources to establish a reputational ESG rating for companies it may be that there may simply be more widespread evidence and attention on the adverse environmental

impacts of bigger chemical companies' operations. The GHG control variable exhibits an all-around positive correlation with ESG ratings although all regressions are highly statistically insignificant. The cause for this may be an insufficiently large sample. Many companies did not release the GHG intensity metrics until past 2010 likely due to a lack of regulatory requirements to do so.

In the second round of regressions, we included fixed time effects to control for the overall improvement in ESG disclosure over time that most firms exhibit. This allows us to control for any variation that may occur as a trend over time due to unmeasured variables such as possible changes in regulatory requirements for ESG ratings that may have led to general trends of improvement in disclosure indexes over time. Integrating fixed effects eliminate unmeasured variation due to company specific effects. Doing so did not change the directions of any of the observed relationships. The fixed time effects led to slight increases in the observed p-values, however without sacrificing statistical significance. This strengthens the overall observations and allows us to assume a negative relationship between short run ESG ratings and all four disclosure indexes.

When we include both time and company effects to control for any effects impact ESG disclosure or operational practices in chemical producers the results demonstrate a mixture of positive and negative relationships between ESG ratings and the independent variables. These however are highly statistically insignificant given that the p-values from this round of regression far exceeds the critical value of 0.05. Without fixed company effects the average r-squared value of the regressions is 0.31 (both without fixed effects and with only fixed time effects). When fixed time and company effects are included together the r-squared exceeds 0.75 on all regressions for the linear and non-linear models. This indicates that there are underlying

fixed effects but that a larger sample size of companies and a longer time horizon are perhaps needed to achieve more statistically significant results.

In order to improve these results a greater sample of data is perhaps needed. The data was limited to a time period stretching back to 2007 which is when ESG ratings and disclosure indexes were instated. A greater selection of companies may also have help however these were limited in terms of data availability for ESG ratings and indexes. ESG ratings are still a young concept and despite its quick growth only around a third of public companies are subject to them. As more firms' operations become subject to ESG criteria and ratings this will allow for more expansive studies in the future.

Long Run Findings

For the long run analysis, the same regressions from the short run analysis were run with a three-year time lag. Thus, every ESG rating data point was run against the ESG disclosure index from three years earlier. This presented a slight limitation as it decreased the size of the data set, seeing as we could no longer consider any disclosure data after the year 2017. A three-year time lag was the longest I was able to investigate as the data set would have been too limited in size to still gain statistically significant results. The conducted regression analysis shows that ESG disclosure and its individual components are also significant determinants of ESG ratings in the long run. Contrary to expectations overall ESG disclosure as well as its individual components exhibit a negative relationship with ESG ratings in the long run. This poses a contradiction to the work of Giudice et al. (2020) as it implies that even in the long run chemical firms that report well and are apparently willing to invest in ESG disclosure lack the will or the means to implement effective policies to improve their ESG performance. Again, this effect may be due to

a combination of the fact that RepRisk ratings are not based on self-reported information and the nature of the sector means that all firms have significantly adverse environmental and thus social effects that are being picked up. Therefore, even if a firm demonstrates awareness in spotting the adverse ESG effects of their operations and proposes solutions through their ESG disclosure this does not get factored in. Another possible explanation is that chemical companies may not yet have the technology to effectively mitigate their adverse environmental and social impact and that this will be achieved over a longer time horizon than three years. Regarding this idea, we are limited by the size of the data set which only stretches back to 2007. Future studies may give a better indication as to why firms that demonstrate obvious conscientiousness about ESG issues through a high ESG disclosure index are not able to increase their ratings in the long run, even though the benefit of high ESG ratings on financial performance is widely recognized. Similarly to the short run analysis, this round of regressions shows a highly statistically significant positive relationship between GDP and ESG ratings in the short and a statistically significant negative relationship between revenue and short run ESG ratings. This confirms the referenced Environmental Kuznet's Curve hypothesis and the idea that bigger chemical companies simply do more environmental and social damage which is reflected through lower ESG ratings. Strangely we find that in the long run GHG intensity exhibits a statistically positive correlation with ESG ratings when regressed alongside ESG disclosure, E disclosure, and G disclosure respectively. Seeing as GHG intensity is the most material criteria to the compilation of ESG ratings according to the SASB this finding is highly counterintuitive and raises doubt about the RepRisk method of ESG compilation ratings. Given, GHG intensity is a self-reported metric and RepRisk states that it does not consider self-reported information. However, this may imply a major limitation in this approach as high greenhouse gas emission is one of the most detrimental

environmental impacts on the environment and ESG ratings are meant to reflect such adverse effects in order to reduce information asymmetry for investors.

As we include fixed time effects we witness a similar pattern as in the short run analysis, whereby the overall p-values increase slightly but all correlations stay the same and remain statistically significant. Including both fixed time and company has the same effect as in the short run analysis as it simply removes all statistical significance from the regressions. Similar to the short run analysis, including both fixed time and company effects eliminates statistical significance but improves the goodness of fit as measured by the r-squared value to upwards of 0.75 as opposed to an average of 0.31 without fixed effects and with only fixed time effects. This indicates that there is an underlying fixed effect but that larger sample size of companies and a longer time horizon are perhaps needed to achieve more statistically significant results.

VI. Conclusion

Throughout this thesis I investigated the effect of ESG reporting quality as measured by disclosure indexes on ESG ratings in short and long run for companies operating in the chemicals sector. By doing so I contributed to filling a gap in the existing literature about the impact of sustainability reporting quality on ESG ratings, the main factor that is hypothesized in previous works to explain a commonly observed positive relationship between firm size and ESG ratings. Through our analysis we established a negative relationship between ESG disclosure quality and ESG ratings in both the short and long run. We also, contrary to the existing literature, observed a negative relationship between firm size as gauged by revenue and ESG ratings. If we consult the existing literature and consider the fact that this study focused exclusively on companies operating in the chemical sector, we can interpret these results in three

different ways. Inherently, the operations of chemical companies have a significantly adverse effect on the environment. The high presence of chemical companies in the Political Economy Research Institute's Toxic 100 attests to this. Therefore, in this sector it may be that we are observing a negative relationship between revenue and ESG ratings, as bigger companies simply do more damage. A second consideration is that companies do not yet have access to the technology to cost effectively mitigate their environmental impacts and that it will take those companies that are demonstrating awareness and practicing transparency through good ESG disclosure more time to implement effective ESG policies. This may be observable over a longer time horizon than what was available for this study. The idea that firms are aware of their ESG impacts and simply not willing to address them seems unlikely given the extensive literature on the benefits of good ESG ratings on financial performance. If we interpret the negative relationship between ESG disclosure and ESG ratings as a causal one this poses worrying implications for several stakeholders. If firms are penalized with lower ESG ratings for effectively disclosing ESG information this provides an incentive for firms to report less and potentially attempt to cover up the environmental and social damage of their operations. Such an incentive may have detrimental implications for stakeholders who are directly affected by chemical companies' pollution, for workers who may be exploited, and for investors who would be misinformed about the ESG risks of their shares in chemical companies.

VII. Appendix

Table 7: *Regressions 1-4, Results without Fixed Effects*

Variable	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%
ESG Disclosure	-1.94×10^{-2} 4.16×10^{-3} *	-2.44×10^{-2} 5.29×10^{-3} *						
E Disclosure			-1.53×10^{-2} 3.18×10^{-3} *	-1.81×10^{-2} 4.00×10^{-3} *				
S Disclosure					-9.73×10^{-3} 3.22×10^{-3} *	-1.34×10^{-2} 4.12×10^{-3} *		
G Disclosure							-1.69×10^{-2} 5.14×10^{-3} *	-1.74×10^{-2} 5.66×10^{-3} *
GDP	3.86×10^{-5} 3.13×10^{-7} *	3.91×10^{-5} 3.85×10^{-7} *	3.84×10^{-5} 2.87×10^{-7} *	3.87×10^{-5} 3.85×10^{-7} *	3.72×10^{-5} 3.22×10^{-7} *	3.87×10^{-5} 3.85×10^{-7} *	3.85×10^{-4} 4.11×10^{-7} *	3.87×10^{-4} 4.00×10^{-7} *
Rev	-3.51×10^{-5} 1.77×10^{-7} *	-3.39×10^{-5} 4.44×10^{-7} *	-3.50×10^{-5} 4.65×10^{-7} *	-3.41×10^{-5} 4.47×10^{-7} *	-3.75×10^{-5} 3.14×10^{-7} *	-3.41×10^{-5} 4.47×10^{-7} *	-3.70×10^{-5} 3.98×10^{-7} *	-3.68×10^{-5} 4.77×10^{-7} *
GHG	1.87×10^{-4} 1.34×10^{-4}	3.78×10^{-4} 1.38×10^{-4} *	1.62×10^{-4} 1.34×10^{-4}	1.39×10^{-4} 1.39×10^{-4} *	1.77×10^{-4} 1.35×10^{-4}	3.45×10^{-4} 1.39×10^{-4} *	2.30×10^{-4} 2.11×10^{-4}	4.14×10^{-4} 1.42×10^{-4} *
R-Squared	0.317	0.308	0.315	0.306	0.312	0.300	0.319	0.294

Table 8: *Regressions 1-4, Results with Fixed Time Effects*

Variable	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%
ESG Disclosure	-1.61×10^{-2} 4.31×10^{-3} *	-2.35×10^{-2} 5.61×10^{-3} *						
E Disclosure			-1.32×10^{-2} 3.22×10^{-3} *	-1.73×10^{-2} 4.14×10^{-3} *				
S Disclosure					-6.90×10^{-2} 3.35×10^{-3} *	-1.22×10^{-2} 4.37×10^{-3} *		
G Disclosure							-1.20×10^{-2} 5.38×10^{-3} *	-1.56×10^{-2} 5.77×10^{-3} *
GDP	3.94×10^{-5} 3.20×10^{-7} *	3.93×10^{-5} 3.89×10^{-7} *	3.94×10^{-5} 3.20×10^{-7} *	3.90×10^{-5} 3.90×10^{-7} *	3.83×10^{-5} 3.21×10^{-7} *	3.80×10^{-5} 3.98×10^{-7} *	3.91×10^{-5} 3.35×10^{-7} *	3.88×10^{-5} 4.04×10^{-7} *
Rev	-3.51×10^{-5} 4.00×10^{-7} *	-3.42×10^{-5} 4.53×10^{-7} *	3.48×10^{-5} 4.01×10^{-7} *	-3.45×10^{-5} 4.57×10^{-7} *	-3.72×10^{-5} 4.00×10^{-7} *	-3.73×10^{-5} 4.61×10^{-7} *	-3.68×10^{-5} 4.10×10^{-7} *	-3.71×10^{-5} 4.83×10^{-7} *
GHG	1.20×10^{-4} 1.36×10^{-4}	3.66×10^{-4} 1.45×10^{-4} *	9.41×10^{-4} 1.34×10^{-4}	3.25×10^{-4} 1.44×10^{-4} *	9.99×10^{-4} 1.37×10^{-4}	3.38×10^{-4} 1.45×10^{-4} *	1.39×10^{-4} 1.40×10^{-4}	3.82×10^{-4} 1.50×10^{-4} *
R-Squared	0.325	0.312	0.324	0.311	0.321	0.301	0.327	0.299

Table 9: *Regressions 1-4, Results with Fixed Time & Company Effects*

Variable	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%
ESG Disclosure	4.18×10^{-3} 5.77×10^{-3}	-2.25×10^{-3} 7.92×10^{-3}						
E Disclosure			6.67×10^{-3} 4.67×10^{-3}	2.97×10^{-3} 6.21×10^{-3}				
S Disclosure					5.15×10^{-3} 4.52×10^{-3}	-4.69×10^{-3} 5.45×10^{-3}		
G Disclosure							-1.08×10^{-2} 4.82×10^{-3} *	-5.50×10^{-3} 6.64×10^{-3}
GDP	5.13×10^{-7} 9.12×10^{-7}	1.94×10^{-7} 1.06×10^{-5}	3.72×10^{-7} 9.01×10^{-7}	6.14×10^{-7} 1.05×10^{-5}	4.15×10^{-7} 9.17×10^{-7}	3.53×10^{-7} 1.08×10^{-5}	6.24×10^{-7} 8.85×10^{-7}	1.33×10^{-7} 1.06×10^{-5}
Rev	-2.68×10^{-5} 5.87×10^{-7} *	-1.74×10^{-5} 1.02×10^{-5}	-2.65×10^{-5} 5.87×10^{-7} *	-1.75×10^{-5} 1.02×10^{-5}	-2.66×10^{-5} 5.81×10^{-7} *	-1.77×10^{-5} 1.02×10^{-5}	-2.61×10^{-5} 6.92×10^{-7} *	-1.69×10^{-5} 1.02×10^{-5}
GHG	-9.25×10^{-5} 2.64×10^{-4}	1.49×10^{-4} 2.76×10^{-4}	-6.48×10^{-4} 2.71×10^{-4}	1.86×10^{-4} 2.73×10^{-4}	-7.31×10^{-5} 2.61×10^{-4}	1.16×10^{-4} 2.76×10^{-4}	-1.59×10^{-4} 2.78×10^{-4}	1.54×10^{-4} 2.76×10^{-4}
R-Squared	0.793	0.756	0.793	0.756	0.794	0.757	0.795	0.757

Table 10: *Regressions 5-8, Results without Fixed Effects*

Variable	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%
ESG Disclosure	-2.15×10^{-2} 4.29×10^{-3} *	-2.78×10^{-2} 5.34×10^{-3} *						
E Disclosure			-1.78×10^{-2} 3.26×10^{-3} *	-2.15×10^{-2} 4.03×10^{-3} *				
S Disclosure					-9.14×10^{-2} 3.31×10^{-3} *	-1.33×10^{-2} 4.13×10^{-3} *		
G Disclosure							-1.55×10^{-2} 5.37×10^{-3} *	-1.77×10^{-2} 6.25×10^{-3} *
GDP	4.44×10^{-5} 3.20×10^{-7} *	4.35×10^{-5} 3.98×10^{-7} *	4.44×10^{-5} 3.18×10^{-7} *	4.35×10^{-5} 3.98×10^{-7} *	4.36×10^{-5} 3.23×10^{-7} *	4.29×10^{-5} 4.04×10^{-7} *	4.44×10^{-5} 3.34×10^{-7} *	4.35×10^{-5} 4.14×10^{-7} *
Ln(Rev)	-1.70×10^{-1} 3.58×10^{-2} *	-1.81×10^{-1} 4.13×10^{-2} *	-1.76×10^{-1} 3.55×10^{-2} *	-1.94×10^{-1} 4.13×10^{-2} *	-1.87×10^{-1} 3.65×10^{-2} *	-1.97×10^{-1} 4.27×10^{-2} *	-1.82×10^{-1} 3.78×10^{-2} *	-1.96×10^{-1} 4.52×10^{-2} *
Ln(GHG)	1.42×10^{-2} 2.12×10^{-2}	6.57×10^{-2} 2.74×10^{-2} *	1.02×10^{-2} 2.12×10^{-2}	6.01×10^{-2} 2.74×10^{-2} *	1.99×10^{-3} 2.16×10^{-2}	4.96×10^{-2} 2.77×10^{-2}	1.60×10^{-2} 2.14×10^{-2}	6.69×10^{-2} 2.95×10^{-2} *
R-Squared	0.285	0.282	0.289	0.283	0.272	0.264	0.274	0.261

Table 11: *Regressions 5-8, Results with Fixed Time Effects*

Variable	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%
ESG Disclosure	-1.73×10^{-2} 4.46×10^{-3} *	-2.67×10^{-2} 5.68×10^{-3} *						
E Disclosure			-1.53×10^{-2} 3.30×10^{-3} *	-2.06×10^{-2} 4.18×10^{-3} *				
S Disclosure					-5.51×10^{-3} 3.43×10^{-3}	-1.16×10^{-2} 4.36×10^{-3} *		
G Disclosure							-8.47×10^{-3} 5.75×10^{-3}	-1.50×10^{-2} 6.47×10^{-3} *
GDP	4.54×10^{-5} 3.25×10^{-7} *	4.38×10^{-5} 4.02×10^{-7} *	4.54×10^{-5} 3.23×10^{-7} *	4.38×10^{-5} 4.02×10^{-7} *	4.49×10^{-5} 3.30×10^{-7} *	4.33×10^{-5} 4.10×10^{-7} *	4.52×10^{-2} 3.36×10^{-7} *	4.38×10^{-5} 4.18×10^{-7} *
Ln(Rev)	-1.78×10^{-1} 3.57×10^{-2} *	-1.86×10^{-1} 4.15×10^{-2} *	-1.81×10^{-1} 3.54×10^{-2} *	-1.99×10^{-1} 4.15×10^{-2} *	-1.95×10^{-1} 3.64×10^{-2} *	-2.05×10^{-1} 4.29×10^{-2} *	-1.93×10^{-1} 3.78×10^{-2} *	-2.04×10^{-1} 4.57×10^{-2} *
Ln(GHG)	3.01×10^{-3} 2.17×10^{-2}	6.41×10^{-2} 2.82×10^{-2} *	1.85×10^{-4} 2.14×10^{-2}	5.79×10^{-2} 2.79×10^{-2} *	-9.13×10^{-3} 2.19×10^{-2}	4.69×10^{-2} 2.83×10^{-2}	-1.72×10^{-3} 2.22×10^{-2}	6.11×10^{-2} 4.57×10^{-2} *
R-Squared	0.301	0.286	0.305	0.289	0.292	0.270	0.292	0.268

Table 12: *Regressions 5-8, Results with Fixed Time & Company Effects*

Variable	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%	SR Coef. (Std. Error) *=statistically significant at 5%	LR Coef. (Std. Error) *=statistically significant at 5%
ESG Disclosure	6.06×10^{-3} 5.86×10^{-3}	-2.70×10^{-3} 7.74×10^{-3}						
E Disclosure			8.04×10^{-3} 4.63×10^{-3}	2.56×10^{-3} 6.13×10^{-3}				
S Disclosure					6.26×10^{-3} 4.67×10^{-3}	-4.48×10^{-3} 5.39×10^{-3}		
G Disclosure							-1.00×10^{-2} 4.97×10^{-3} *	-6.03×10^{-3} 6.66×10^{-3}
GDP	3.95×10^{-7} 9.28×10^{-7}	1.47×10^{-7} 1.06×10^{-5}	2.69×10^{-7} 9.16×10^{-7}	2.23×10^{-7} 1.05×10^{-5}	3.08×10^{-7} 9.33×10^{-7}	2.80×10^{-7} 1.09×10^{-5}	5.66×10^{-7} 9.05×10^{-7}	8.10×10^{-7} 1.06×10^{-5}
Ln(Rev)	-2.37×10^{-1} 5.69×10^{-2} *	-1.10×10^{-1} 1.03×10^{-1}	-2.35×10^{-1} 5.71×10^{-2} *	-1.13×10^{-1} 1.03×10^{-1}	-2.34×10^{-1} 5.65×10^{-2} *	-1.12×10^{-1} 1.03×10^{-1}	-2.22×10^{-1} 5.73×10^{-2} *	-1.04×10^{-1} 1.03×10^{-1}
Ln(GHG)	-3.87×10^{-2} 8.96×10^{-2}	8.64×10^{-3} 1.28×10^{-1}	-2.74×10^{-2} 9.00×10^{-2}	1.95×10^{-2} 1.28×10^{-1}	-3.62×10^{-2} 8.98×10^{-2}	2.62×10^{-3} 1.28×10^{-1}	-4.18×10^{-2} 9.10×10^{-2}	1.90×10^{-2} 1.28×10^{-1}
R-Squared	0.768	0.755	0.769	0.755	0.768	0.755	0.769	0.755

VIII. References

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