Sustainability Disclosure and Performance

An Empirical Study of U.S. Petroleum Corporations

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This thesis was written as a part of the Master of Science in Economics and Business Administration at NHH. Please note that neither the institution nor the examiners are responsible – through the approval of this thesis – for the theories and methods used, or results and conclusions drawn in this work.
Preface

This master’s thesis marks the end of our Master of Science in Economics and Business Administration at the Norwegian School of Economics. We have studied the nature of eight U.S. petroleum companies’ attitude towards sustainability by using textual data analysis.

During our major in finance, both of us had *Applied Textual Data Analysis for Business and Finance*. The subject yielded a thorough introduction to the programming language R along with the quantification of textual data to conduct analysis. Moreover, both of us possess a genuine interest for the field of sustainability, gained from subjects at NHH and previous internships. Thus, to apply textual data analysis to investigate petroleum companies’ attitude towards sustainability was a fitting issue for our thesis.

Moreover, we would like to offer our gratitude to our advisor Maximillian Rohrer. Thank you for offering valuable guidance and feedback throughout the semester.

Finally, we would like to thank our families. Without their support, the road towards submission would not have been the same. They motivated us to proceed and not forget to have fun at the same time. Thank you.
Abstract

This thesis investigates if some of the largest U.S. petroleum companies’ written disclosure regarding sustainability is correlated with their sustainability performance. We measure the companies’ written disclosure with textual data analysis, conducted on annual reports (10-K), event reports (8-K) and sustainability reports. Furthermore, we represent the sustainability performance with the indicators greenhouse gas emissions, total recordable incident rate and environmental expenditures, which represent the environmental, social and economic dimension of sustainability, respectively. We find that the companies’ combined written disclosure is not correlated with the companies’ sustainability performance. However, when analysing the disclosure document measures individually, we observe that how much the companies write about sustainability correlates less with their performance, compared to when they write positive or negative.
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1. Introduction

In 2011, a court in Ecuador fined Chevron 8.6 billion USD for damages on crops and farm animals, as well as increased local cancer rates due to reckless oil drilling (The New York Times, 2011). Yet, in Chevron’s sustainability report for 2011 (Chevron, 2011), the company cherishes their land-conservation program in Indonesia, whereas the incident in Ecuador is not mentioned. Moreover, Global Witness (2018) claims that in 2013, ExxonMobil signed a 120 million USD deal with the Liberian government, even though they knew the government was tainted by corruption. However, they state nothing about this accusation in their sustainability report for 2013, while claiming that “ExxonMobil is committed to the highest standards of business conduct and anti-corruption wherever we operate” (ExxonMobil, 2013). These examples illustrate that U.S. petroleum companies’ sustainability disclosure is potentially not correlated with their sustainability performance. Hence, we question their integrity by investigating the following thesis:

“Is the written disclosure regarding sustainability correlated with the sustainability performance, among eight of the largest U.S. petroleum companies?”

We define sustainability in accordance with Global Reporting Initiative’s (GRI) (2011) definition, being “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. In the same report, GRI divide sustainability into three dimensions: environmental, social and economic. To represent the companies’ sustainability performance, we extract three indicators, one for each of the three dimensions. The performance measures are the companies’ greenhouse gas emissions (GHG), total recordable incident rate (TRIR) and environmental expenditures. These are retrieved from the Carbon Majors database (Paul, Heede, & Flugt, 2017), sustainability reports and annual reports (10-K), respectively.

We represent the written disclosure by quantitative measures which describes how the petroleum companies write about sustainability. These measures are computed with word frequencies and sentiment analysis on the companies’ annual reports, event report (8-K) and
sustainability reports. From these documents, we construct six independent variables, which henceforth are referred to as the textual variables.

In order to investigate the correlation between the companies’ written disclosure and their performance, we construct three regression tables. The table of the environmental, social and economic dimension has GHG, TRIR and environmental expenditures as its dependent variable, respectively. Moreover, the independent variables are a combination of textual and control variables. First, we analyse the correlation between the textual variables and the sustainability performance when all textual variables are included in the regression. Second, we assess the correlation by reviewing the textual variables individually. Our hypothesis, being that the companies’ written disclosure regarding sustainability is not correlated with their performance, is rejected if the textual variables’ coefficients are significant.

While there are several limitations to our thesis, our main result supports that the eight U.S. petroleum companies’ combined written disclosure regarding sustainability is not correlated with their sustainability performance. However, when we interpret the textual variables individually, the results suggest that how much they write about sustainability correlates less with their performance compared to when they write positive or negative.
2. Background

United Nations states that “after more than a century and a half of industrialization, deforestation, and large-scale agriculture, quantities of greenhouse gases in the atmosphere have risen to record levels not seen in three million years” (United Nations, u.d.). These emissions contribute to global warming, which in turn leads to for example higher sea levels and more extreme weather (National Ocean Service, 2018). Moreover, Carbon Majors (2017) states that 50 % of GHG emissions origins from production and use of oil and gas products. Therefore, we argue that emissions from petroleum companies have a considerable global impact on the environment.

The petroleum industry is also accountable for several incidents which had an impact on local environments. For instance, the Exxon Valdez oil tanker released about 350 000 barrels of oil into the Prince William Sound in Alaska in 1989 (Shin, 2017). The incident resulted in the death of 2000 sea otters, about 250 000 thousand birds and pollution of 1990 square kilometers of shoreline (Bright Hub Engineering, u.d.). Another example is the Deepwater Horizon incident, in which four million barrels of oil were spilled and 11 persons were killed (Milman, 2018). Thus, consequences from petroleum incidents are potentially extensive. This also means that petroleum companies’ incident risk management may have an impact on stakeholders like the government, local communities and natural habitats.

By improving their local and global impact, we argue the petroleum companies can also increase their profitability. Alshehhi, Nobanee & Khare (2018) finds that 78 % of publications regarding the relationship between corporate sustainability and financial performance, finds a positive relation. For instance, increased focus on sustainability can save costs and improve a company’s reputation. Efficiency-increasing efforts, like new drilling technology, can reduce energy consumption, which in turn reduces costs and emissions. Further, companies which address sustainability have become increasingly popular for investors (Forbes, 2017). Thus, by gaining a reputation of being socially responsible, firms can expect a positive development in their stock prices and their ability to raise capital. We do observe that several petroleum companies, like BP (BP, 2018) and Equinor (Equinor, 2018), address sustainability by redesignating themselves to broad energy
companies, with an increased focus on renewable energy. Nevertheless, renewable energy is still only a small portion of their operations (Aras & Crowther, 2008).

Even though some petroleum companies have initiated sustainability efforts, we question their true incentives. An analysis of 49 Fortune-500 firms by Orniston & Wong (2013), found that corporate social responsibility efforts predicted subsequent corporate social irresponsibility. The study raises the discussion of moral licensing, meaning that good responsible behaviour justifies social irresponsibility. We observe examples of potential moral licensing in the petroleum industry. E.g., according to The U.S. Fish and Wildlife Service (Fears, 2017), “the single most important achievement for polar bear conservation is decisive action to address Arctic warming”. Hence, the emissions from petroleum companies are contributing to destroying polar bear habitats. However, we observe that ExxonMobil (ExxonMobil, u.d.) and ConocoPhillips (Environmental Studies Program, 2005) ironically have polar bear protection programs. Thus, the petroleum companies may also address sustainability to justify their negative local and global impacts.

Furthermore, if 78% of publications suggests there is a business case for sustainability, why do not all companies implement sustainability? Crowther (2002) emphasize that financial and sustainability performance are by some regarded as conflicting with one another. This perception of sustainability might exist because there is no universal definition of what sustainability encompasses (Johnston, Everard, Santillo, & Robèrt, 2007). Due to this vague definition, top corporate executives may place less faith in sustainability research, and thus trust their own beliefs and experiences instead. For instance, U.S. top executives’ political affiliation can reveal deviating beliefs in terms of sustainability. Compared to democrats, republicans tend to be more sceptical regarding sustainability subjects, like human contribution to global warming (Popovich & Albeck-Ripka, 2017). The deviating beliefs on sustainability may clarify why Chin, Hambrick & Trevino (2013) find that companies with republican CEOs tend to invest less in corporate social responsibility than democratic CEOs. Therefore, beliefs on sustainability among top executives can affect companies’ will to address the subject.

To summarize, the petroleum industry’s impact on the world is considerable, which emphasizes the need to address sustainability in this sector. By addressing sustainability, the petroleum companies can benefit by saving costs and improve their reputation. We do
observe that some petroleum companies are starting to change their impact on the world. Yet, their true incentives for addressing sustainability may be questionable. For example, sustainability may be accommodated to justify irresponsible behaviour. In addition, different beliefs among U.S. top executives may also contribute to explain why sustainability is not implemented in a greater extent.
3. Literature Review

In this section we review two articles which can be related to textual data analysis on sustainability-related issues. Barkemeyer, Comyns, Figge & Napolitano (2014) conduct sentiment analysis on CEO statements from corporate sustainability reports to see if the rhetoric used in sustainability reporting accurately reflects sustainability performance. Their results indicate that sustainability reporting has not matured over the period they choose, and that the rhetoric used in the CEO statements is superficial rather than accountable. Wen (2014) develops two main algorithms, the first regress word frequencies from 10-K annual reports against a published sustainability score. The second conduct sentiment analysis on the same annual reports to analyse the positive and negative sentiment on sentences which contain sustainability-related words. The result of the first main algorithm indicates there is no significant correlation between the frequency of sustainability-related words and sustainability score. As regards the second main algorithm, no conclusions are made.

First of all, we contribute to the existing literature by using several document types. The other articles apply one type of document on which they perform textual analysis. We conduct analyses on the 10-K annual reports, 8-K event reports and sustainability reports, yielding six textual variables. Thus, the analysis scope of existing literature, both in terms of document types and number of textual variables, is less extensive. Second, the terms we use to describe sustainability is chosen with a quantitative and qualitative analysis, in contrast to Wen’s (2014) article in which similar terms are chosen solely with algorithms.
4. **Companies and Years**

According to the Climate Accountability Institute (2017), the world’s 100 largest fossil fuel producers are linked to 71% of industrial greenhouse gas emissions since 1988. Of those 100 fossil fuel producers, we review the following eight U.S. corporations:

- Anadarko Petroleum Corporation
- Apache Corporation
- Chevron Corporation
- ConocoPhillips
- ExxonMobil Corporation
- Hess Corporation
- Marathon Oil Corporation
- Occidental Petroleum Corporation

We select U.S. companies to utilize the data disclosed on the U.S. Securities and Exchange Commission’s (SEC) web pages (8-Ks and 10-Ks). In addition, we do not include other countries due to deviating reporting standards and rules, and thus incomparable reports. Moreover, we consider the years 2004 - 2015, since we observe that these years involve relatively consistent sustainability reporting compared to the years prior to 2004. We limit the years to 2015, since the Carbon Majors dataset does not include GHG emissions for the years 2016 - 2018.
5. Data Foundation

5.1 10-K Annual Reports

U.S. public companies are required to produce an annual report each year and file it with the SEC. The commission requires that annual reports follow the form of 10-K. The 10-K form contains a detailed picture of a company’s business, the risk it faces, and the operating and financial results for the fiscal year. (U.S. Securities and Exchange Commission, 2011)

<table>
<thead>
<tr>
<th>Words in Annual Reports</th>
<th>Total</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2898065</td>
<td>30188</td>
<td>6078</td>
<td>17860</td>
<td>42595</td>
</tr>
</tbody>
</table>

*Figure 1 - Descriptive Statistics of Annual Reports*

We gather one annual report per firm over the 12 years, yielding a total of 96 reports. A 10-K report from our sample has 30188 words on average. The standard deviation of 6078 indicates that relatively to the mean, there is small variation in the annual reports, compared to the other document types (Figure 2 and 3). The relatively low variation can be explained by the strict set of rules entailed with the 10-K annual reports.

5.2 Sustainability Reports

The sustainability reports follow the reporting standards established by the Global Reporting Initiative. These standards include information about a company’s economic, environmental and social impact. Furthermore, these reports present the corporation’s values and governance model, and demonstrate the link between the company’s strategy and its efforts to address sustainability. (Global Reporting Initiative, u.d.)

We mainly retrieve the sustainability reports from GRI’s web pages, however, some are collected from the companies’ websites. We collect a total of 57 reports, most of which were published during the later years of those we regard. The reports from recent years contain
tables with key performance indicators, which can be used to assess a company’s sustainability performance.

As can be seen from figure 2, the average number of words for each report is 14755, meaning the sustainability reports tend to be shorter than the annual reports. However, with a standard deviation of 7775 words, these reports have relatively greater variation in length compared to the annual reports.

**5.3 8-K Event Reports**

In addition to filing annual reports on form 10-K, public companies must report certain corporate events on a current basis. Examples on such events are termination of a material definitive agreement, bankruptcy or acquisition of assets. These major events require the 8-K report form. (U.S. Securities and Exchange Commission, u.d.)

We observe that the total number of words is lower than both the annual reports and the sustainability reports. Moreover, the firm standard deviation per year is relatively high, compared to the other document types. The standard deviation indicates a large variation in published reports.

For the years 2004 - 2015, our selected companies published a total of 1190 event reports, which yields an average of 148.8 reports per company. On average, the companies file 12.4
reports annually, which is approximately one report per month. However, due to the standard deviation of 4.4, and a range of 25, the reporting tends to be inconsistent. To investigate which extent the 8-Ks emphasize sustainability, we conduct an analysis to determine if the terms in the event reports resembles the annual or the sustainability reports (Appendix 12.1). Our result suggests that the event reports are more similar to the 10-Ks, and thus contain financial content rather than sustainability-oriented issues.

5.4 Vector to Analyse Written Disclosure on Sustainability

In order to analyse the written disclosure on sustainability, we construct the following vector, which consists of sustainability-related terms, and their inflected forms.

| environment | greenhouse |
| safety       | citizenship |
| water        | conservation |
| emission     | integrity   |
| health       | flare       |
| human        | biodiversity |
| social       | community   |
| incident     | diversity   |
| climate      | transparency |
| sustainable  | renewable   |
| spill        | corruption  |
| stakeholder  | wildlife    |
| waste        | footprint   |

Figure 5 - The Relevant Words Vector

The inflected forms are omitted in figure 5 due to readability purposes. To construct this vector, we use the following quantitative assessment. First, terms from all of the sustainability reports are assembled in a vector, and terms with a frequency of less than 200
are excluded. Then, inflected forms are collapsed into their shortest form, and their frequencies added together. Subsequently, the 200 most frequent words are assembled into a vector (Appendix 12.2). This approach may reveal the most common and relevant words for sustainability in the petroleum industry. For example, an industry specific word is “flare” or “flaring”, which is a common cause of direct greenhouse gas emissions (Emam, 2015).

Finally, we use a qualitative assessment to determine which terms from the frequency vector fit into the dimensions of sustainability. We regard this assessment as necessary because many words in the initial frequency vector are unrelated to sustainability, like “company” and “operation”. Furthermore, some of the terms, like “responsible”, are used in different contexts in the text documents. E.g. “Responsible” is mainly used in annual reports and event reports to describe a responsible attitude towards financial risk, whereas in the sustainability reports, the term is used to address responsibility towards externalities. Thus, the written disclosure on sustainability can be biased if those words are included.
6. Independent Textual Variables

In this section, we construct six independent textual variables, with the use of two textual approaches on 10-Ks, 8-Ks and sustainability reports. The first is the rate, for each firm, of sustainability-related words relative to the total amount of words for a document type over one year. The second is the sentiment of sentences containing sustainability-related words on the various document types. The first method examines the relative amount of which the companies write about sustainability-oriented issues, and the second investigates to which extent they write positive or negative about sustainability.

6.1 Relevant Words’ Fraction of 10-Ks and 8-Ks

We calculate the Relevant Words’ Fraction 10-K by taking the sum of the frequency of the words from the Relevant Words Vector for each 10-K, and dividing it by the total number of words in the respective 10-K. Furthermore, in the 8-Ks, the sum of the sustainability-related words is divided by the total amount of words for all 8-Ks for a given year and firm, resulting in 96 observations. However, many of the 8-K reports contain no sustainability-related words, which yields several zero values. The purpose of both variables is to measure how much the companies write about sustainability-oriented matters. Therefore, an increase in the rate represents that the companies’ written disclosure regarding sustainability increases.

<table>
<thead>
<tr>
<th>Relevant Words’ Fraction</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Missing Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-K</td>
<td>0.49 %</td>
<td>0.15 %</td>
<td>0</td>
</tr>
<tr>
<td>8-K</td>
<td>0.05 %</td>
<td>0.06 %</td>
<td>0</td>
</tr>
</tbody>
</table>

*Figure 6 - Descriptive Statistics of Relevant Words’ Fraction*

As can be seen from figure 6, the average implies that the words related to sustainability in the 10-Ks and 8-Ks constitutes 0.49 % and 0.05 % of the report, respectively. Thus, sustainability is addressed in a greater extent in the annual reports compared to the event reports. Additionally, we observe that the standard deviation is greater than the mean for the
event reports, which implies a relatively large variation between firms and years compared to the 10-Ks.

6.2 Sustainability Report Dummy

Since we only have 57 sustainability reports, a potential relevant words’ fraction of sustainability reports will include 39 missing observations. The relatively low number of observations increases the possibility for biased coefficients in the regressions. Therefore, we create a dummy for whether they file a sustainability report as a proxy for the amount of companies’ written disclosure. Thus, if the companies disclose a report, it represents an increase in the written disclosure regarding sustainability.

6.3 Sentiment on Sustainability-Related Sentences in 10-Ks, 8-Ks and Sustainability Reports

For the annual, event and sustainability reports, our script locates all sentences that contains at least one sustainability word from the Relevant Words Vector. Similar to when the Relevant Words’ Fraction 8-K is conducted, all 8-K reports for a given year and firm are collapsed to a single document. We retrieve the sentences by using regular expressions, which is a “search language” used to locate words, sentences or other textual patterns. Furthermore, in our sentiment analysis, the sentences are scanned for words present in the Harvard IV dictionary. We select this general-purpose dictionary due to lack of sustainability-related dictionaries. The dictionary assigns positive and negative words in the sentences a sentiment score. Moreover, the sentiment score of all collapsed sentences for a given year and firm are summarized, yielding a netto sentiment score. Finally, the netto sentiment is divided by the total number of words of all collapsed sentences for a given year and firm. This last computation in our selected sentiment analysis ensures that the scores are comparable for a document type with differing lengths. We select the three sentiment variables as proxies for whether the companies’ written disclosure is positive or negative in terms of sustainability.
We observe that the sentiment is more positive in the sustainability reports than in the other documents. In addition, the sentiment variation in the sustainability reports is also relatively less than the 10-Ks and the 8-Ks. Furthermore, the event reports have a high standard deviation compared to its mean. This can be explained by the high variation in the length of the 8-K reports, which affects the denominator in the sentiment score. The missing values in Sentiment of Sustainability-Related Sentences in 8-K can be explained by the low frequency of sustainability words in these documents. As regards the missing values in the sentiment on sustainability reports, these are explained by the lack of reports for some of the early years. Thus, the inference credibility related to Sentiment of Sustainability-Related Sentences in Sustainability Reports is reduced.
7. The Environmental Dimension

Global Reporting Initiative (2011) states the environmental dimension concerns “an organisation’s impact on living and non-living natural systems, including ecosystems, land, air and water.” Considering that greenhouse gas emissions have an impact on all examples in GRI’s description, we regard emissions as representative for the environmental dimension. Therefore, we consider the following dependent variable:

\[
\text{Emission Rate} = \frac{\text{Greenhouse Gas Emissions}}{\text{Production}}
\]

Greenhouse gas emissions are constituted by Scope 1 and Scope 3 emissions of metric tonnes of CO2 equivalent, whereas production is measured in thousand barrels of oil equivalent. Scope 1 is defined by direct emissions from operations that are owned or controlled by the organisation (Global Reporting Initiative, 2011). For instance, CO2 emissions from fuel powering the oil pumps or chemical release from processing petroleum products at refineries. Scope 3, on the other hand, is indirect emissions from the entire company supply chain. By using a combination of direct and indirect emissions, differences due to various positions in the supply chain are accounted for. For instance, Marathon Oil might have relatively more oil pumps and less refineries than Anadarko. Thus, if only direct emissions are analyzed, Anadarko may have a different emission intensity dependent on their positioning. Hence, by including all indirect emissions, GHG pollution from the whole supply chain is included for each barrel produced. To make GHG emissions comparable across firms, we adjust for production. This computation also ensures that reduced emissions are not a reflection of decreased production. The data used to compute the Emission Rate is gathered from the Carbon Majors database and the 10-Ks.
Figure 8 shows the descriptive statistics for the Emission Rate from 2004 to 2015. On average, the companies pollute 0.43 metric tonnes of CO2 equivalent per thousand barrels of oil equivalent. The range of the mean is 0.11, and the range of the standard deviation is 0.08. There is no missing data for any of the companies.

We conduct a logarithmic transformation of the Emission Rate to account for a potential non-linear trend over time. It is likely that reducing emissions are more feasible from a higher level, but it turns increasingly difficult when emissions are lower. E.g., diminishing technological developments, related to energy use in production or emission filters at refineries. Moreover, the emissions can be reduced, but never turn negative, making a linear relationship unfeasible.
Visually, figure 9 does not indicate any time-specific variation. On the one hand, government regulations can yield a time-fixed effect. E.g., higher fuel standards which was imposed by the Obama administration in 2012 (The White House - Office of the Press Secretary, 2012) can lead to lower Emission Rate. On the other hand, the technological developments in shale oil production in North-America, has increased the activity for this segment (Cai, et al., 2015). Since shale oil production has a 18-21 % higher emissions intensity than conventional crude oil production (Cai, et al., 2015), the advancements in this segment can lead to higher Emission Rate for the later years of those we regard.

Additionally, volatility in the oil price can also result in time-specific effects. For instance, higher oil price opens production on fields with a higher break-even price. Those fields often have greater energy use (Gavenas, Rosendahl, & Skjerpen, 2015), which in turn leads to more GHG emissions per barrel produced. If time-specific effects are not adjusted for, we can get correlation between our textual variables and performance variables, even though the correlation is potentially driven by time-specific variation. We account for this by including year dummies in the regression.

Deviating technology between firms can lead to differences in the GHG per barrel produced. If one firm holds more energy-efficient technology than another, GHG emissions per barrel
produced can differ. Furthermore, while Scope 3 covers indirect emissions in the supply chain, it does not cover differences in the GHG rate due to deviating horizontal positions. Different horizontal positions refer to e.g. that one firm is focused on conventional crude, whereas another is more focused on deepwater production, which can yield differences in GHG intensity. These arguments suggest the presence of firm-specific effects, and thus we include firms dummies in the regression. These ensure, on the same foundation as the year dummies, that the correlations we observe on the textual variables are adjusted for differences across firms.

7.1 Results

In this section, we investigate whether the regression coefficients are significant, in the sense that the companies’ written sustainability disclosure is correlated with their Emission Rate. Our hypothesis is that there is no correlation, meaning the coefficients are statistically insignificant. In the following regressions, we include eleven year dummies and seven firm dummies as control variables. The consequence of adding the dummies is that variation due to firm- or time-specific effects are accounted for. However, the dummies may consume variation in the textual variables. If for instance one textual variable and a control variable are collinear, a potential correlation between the textual variable and the dependent variable can be hidden in the control variable. To account for potential collinearity, all coefficients’ significance is compared to a regression without the control variables. If a textual variable is significant in the regressions without control variables, but turns insignificant with the inclusion of controls, we cannot neglect the possibility that the dummies have consumed the variation. Moreover, if a variable is not significant in the regression with and without firm and year dummies, our conclusion of no correlation is more robust.
Control variables (Appendix 12.11, 12.12 and 12.13) are not shown in figure 10 above for readability purposes. The table consists of eight regressions in which the coefficients estimates are presented, significance level indicated by (*) and standard deviations in parentheses. We use a 10\% level of significance throughout the analyses, since the level of significance should be set as a decreasing function of sample size (Gill, 1999), and our sample size is relatively small. Since missing observations reduce the credibility of coefficient estimates (Kang, 2013), we omit the variables Sentiment of Sustainability-Related Sentences in 8-K and Sentiment of Sustainability-Related Sentences in Sustainability Reports in the multiple regression (7).

None of the coefficients in the multiple regression (7) are significantly different from zero. If Relevant Word’s Fraction 10-K increases with 0.1 percentage points, the Emission Rate decreases with 0.98 \%, all else equal. If Relevant Word’s Fraction 8-K increases with 0.1 percentage points, the Emission Rate increases with 0.44 \%. Furthermore, if a company file a sustainability report, the Emission Rate increases with 2.2 \%. Finally, if Sentiment of Sustainability-Related Sentences in 10-K increases with 0.01, the Emission Rate increases with 0.84 \%. The additional adjusted R\(^2\), gained by going from the control variables regression (8) to the multiple regression (7), is -0.6 percentage points. The negative development suggests that the additional information the textual variables give the model, does not outweigh the loss in efficiency. Hence, we conclude that we cannot reject the
hypothesis that the textual variables are not correlated with the \textit{Emission Rate} after adjusting for firm- and time-fixed effects.

When we compute regression (7) without time- and firm-fixed effects (Appendix 12.7), only \textit{Sentiment of Sustainability-Related Sentences in 10-K} is significantly different from zero. This variable loses significance after the inclusion of controls. Therefore, we cannot neglect the possibility that its insignificance can be a result of consumed variation by the dummies. Moreover, the insignificance of \textit{Relevant Word’s Fraction 10-K}, \textit{Relevant Word’s Fraction 8-K} and \textit{Sustainability Report Dummy}, in both the regressions with and without control variables, gives a more solid conclusion for these three variables.

The negative coefficient of \textit{Relevant Words’ Fraction 10-K} in regression (1) indicates that the companies write more about sustainability-related issues in the annual reports when the \textit{Emissions Rate} decreases, and vice versa. If \textit{Relevant Words’ Fraction 10-K} increases with 0.1 percentage points, the \textit{Emission Rate} decreases with 0.88 \%, all else equal. Moreover, the coefficient is not significantly different from zero. Hence, we have a statistical basis to conclude there is no correlation between the frequency of sustainability-related words in annual reports and the \textit{Emission Rate} when time- and firm-fixed effects are adjusted for. However, when we conduct regression (1) without time- and firm-fixed effects (Appendix 12.7), the coefficient is significant. Thus, we cannot neglect that time- and firm specific effects consume some of the variation, and hence make \textit{Relevant Words’ Fraction 10-K} insignificant.

If \textit{Relevant Words’ Fraction 8-K} in regression (2) increases with 0.1 percentage points, the \textit{Emission Rate} increases with 0.34 \%. The coefficient of \textit{Relevant Words’ Fraction 8-K} in regression (2) is not significant, implying we have the statistical foundation to conclude there is no correlation between the frequency of sustainability-related words in the 8-Ks and the \textit{Emission Rate}. In addition, when we calculate regression (2) without time- and firm-fixed effects (Appendix 12.7), the coefficient is also insignificant. Hence, our conclusion is more robust.

The coefficient of the variable \textit{Sustainability Report Dummy} from regression (3) supports a positive correlation, which implies that if they publish a sustainability report, they have a greater \textit{Emission Rate}. If a company file a sustainability report, the GHG \textit{Emission Rate}
increases with 2.5 %, all else equal. However, the coefficient is not significantly different from zero. Hence, we have the statistical basis to conclude there is no correlation between publishing a sustainability report and their Emission Rate. In addition, when we construct regression (3) without time- and firm-fixed effects (Appendix 12.7), the coefficient is also insignificant, which strengthens the conclusion.

Furthermore, the coefficient sign of Sentiment of Sustainability-Related Sentences in 10-K in regression (4) indicates that if the companies write more positively about sustainability-oriented issues in their annual reports, the Emission Rate increases. If Sentiment of Sustainability-Related Sentences in 10-K increases with 0.01, the Emission Rate increases with 0.62 %. Moreover, the coefficient of Sentiment of Sustainability-Related Sentences in 10-K in regression (4) is not significantly different from zero, which suggests that we can not reject the null hypothesis stating there is no correlation between the variable and the Emission Rate. However, in regression (4) without time- and firm-fixed effects (Appendix 12.7), the coefficient is significant. Thus, the coefficient's insignificance can be explained by consumed variation in the control variables.

The coefficient of Sentiment of Sustainability-Related Sentences in 8-K in regression (5) indicates a negative correlation, meaning that if the companies write more positively about sustainability-related issues in their event reports, the Emission Rate decreases. If Sentiment of Sustainability-Related Sentences in 8-K increases with 0.01, the Emission Rate decreases with 0.5 %. However, we can not reject the null hypothesis stating there is no correlation between the Sentiment of Sustainability-Related Sentences in 8-K and the Emission Rate. Moreover, in regression (5) without time- and firm-fixed effects (Appendix 12.7), the coefficient is not significant. Thus, the robustness of the results increases. However, since the 8-K reports seldom address sustainability, this variable has many missing observations. Thus, we cannot neglect the possibility that the coefficient is biased.

Regarding regression (6), its coefficient of Sentiment of Sustainability-Related Sentences in Sustainability Reports indicates a negative correlation. The negative correlation suggests that if the companies write more positively about sustainability-related issues in their sustainability reports, the Emission Rate decreases. If Sentiment of Sustainability-Related Sentences in Sustainability Reports increases with 0.01, the Emission Rate decreases with 2.4 %, all else equal. Finally, we can reject the null hypothesis, hence we conclude that the
Sentiment of Sustainability-Related Sentences in Sustainability Reports and the Emission Rate are negatively correlated. However, his regression also has many missing observations in the earlier years, which in turn indicates that we can not neglect the possibility of biased results. For instance, bias can be introduced if the sentiment on sustainability reports are significantly higher or lower in the early years we regard. The potential bias reduces the credibility of the significance.
8. The Social Dimension

According to GRI (2018), the social dimension of sustainability “concerns an organization’s impacts on the social systems within which it operates”. A social system is an organisation of individuals into groups or structures that have different functions, characteristics, origin or status (Business Dictionary, u.d.). Hence, we consider the employees as a social system within an organization. Thus, the safety of the employees can be used to represent an impact the organization has on an internal social system. Since the TRIR describes the safety of a company’s employees, the rate fits into the social dimension of sustainability.

The TRIR is total employee incidents per 200 000 work hours. According to the Society of Petroleum Engineers (2017), the most common causes of incidents among employees are road accidents, falls, explosions or fires.

<table>
<thead>
<tr>
<th>Company</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Missing Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anadarko Petroleum Corp</td>
<td>0.47</td>
<td>0.19</td>
<td>4</td>
</tr>
<tr>
<td>Apache Corp</td>
<td>1.25</td>
<td>0.40</td>
<td>4</td>
</tr>
<tr>
<td>Chevron Corp</td>
<td>0.27</td>
<td>0.12</td>
<td>0</td>
</tr>
<tr>
<td>ConocoPhillips</td>
<td>0.13</td>
<td>0.05</td>
<td>4</td>
</tr>
<tr>
<td>ExxonMobil Corp</td>
<td>0.30</td>
<td>0.07</td>
<td>0</td>
</tr>
<tr>
<td>Hess Corp</td>
<td>0.95</td>
<td>0.72</td>
<td>0</td>
</tr>
<tr>
<td>Marathon Oil Corp</td>
<td>0.64</td>
<td>0.17</td>
<td>3</td>
</tr>
<tr>
<td>Occidental Petroleum Corp</td>
<td>0.39</td>
<td>0.07</td>
<td>2</td>
</tr>
</tbody>
</table>

*Figure 11 - Descriptive Statistics TRIR for the Years 2004 - 2015*

The mean rate across firms and years is 0.54, meaning that there is about half an incident per 200 000 work hours. The range of the mean and standard deviation is 1.12 and 0.67, respectively. The TRIR consists of 79 observations, all of which are gathered from the sustainability reports. The missing observations are skewed to the early years, which can be explained by the inconsistency in sustainability reporting these years. This suggests that there might be greater uncertainty to the regression estimates in the early years compared to the later. Contrary to the other companies, Marathon Oil calculates the TRIR for employees and contractors combined. However, an F-test supports that deviating variation is not an issue (Appendix 12.3), and potential level differences can be solved with firm-fixed effects.
In the initial phase of addressing the TRIR, there is a lot of potential for risk reduction, yielding relatively large decreases in the rate. However, after the first adoptions of safety policies and efforts, it becomes increasingly hard to find new potential for risk reduction. In addition, some incidents will never be avoidable, like human failure. Therefore, there will always be some risk of incidents. Moreover, a company can never have a negative number of incidents, making it impossible for the TRIR to be negative. Hence, we choose to conduct a logarithmic transformation of TRIR to account for a percent-wise development. In addition, a test for normality rejects the null hypothesis of a normally distributed variable for the level variable, but normality cannot be rejected for the logged TRIR (Appendix 12.5). This result supports a logarithmic variable.

![Total Recordable Incident Rate](image)

*Figure 12 - The Logarithmic TRIR vs. Years*

Visually, one can argue for a linear time-trend in figure 12, which implies a percent-wise development for the TRIR. However, year-specific shocks in the TRIR can for instance be explained by safety measures imposed by government regulation and/or automatization of hazardous processes across the industry. Moreover, a decrease in the oil price can increase the incident rate, in the sense that petroleum companies tend to cut costs in health and safety measures (Marsh, 2016) in such an event. Due to a sharp oil price decrease, both in 2009 and 2015, shocks in the TRIR might be present in our data. Therefore, in order to accommodate
potential time-specific variation in our data, eleven year-specific dummies are added to our regression.

Furthermore, the visual level differences in figure 12 indicate firm-specific variation. Differing focus on technology might also yield differences across firms. For example, installation of newer and safer machines among some companies are likely to reduce the TRIR. Individual firms can also have different internal safety policies and training of their employees in order to avoid incidents. The firm's position, both horizontally and vertically, can affect their risk of incidents. For example, onshore production leads to greater risk exposure compared to offshore production (Oil & Gas Journal, 2014). Moreover, firm size matter if there is a non-linear relationship between incidents and number of employees. For instance, if the relative number of employees working with risky drilling operations decreases as the firm grows. Hence, we adjust for firm-specific effects by adding seven firm dummies.
8.1 Results

In the following regressions, we include eleven year dummies and seven firm dummies as control variables. The consequence of adding the dummies is that variation due to firm- or time-specific effects are accounted for. However, the dummies may consume variation in the textual variables. Thus, as in the environmental dimension, the regressions with time- and firm-fixed effects below are also compared to the regressions without the control variables (Appendix 12.8).

Control variables are not shown in the regression table for readability purposes. The table consists of eight regressions in which the coefficients estimates are presented, significance level indicated by (*) and standard deviations in parentheses. We still use a 10% significance level to determine significance. We omit the variables Sentiment of Sustainability-Related Sentences in 10-K and Sentiment of Sustainability-Related Sentences in Sustainability Reports in the multiple regression (7).

None of the coefficients in the multiple regression (7) are significantly different from zero. If Relevant Word’s Fraction 10-K increases with 0.1 percentage points, the TRIR increases with 2.65%, all else equal. If Relevant Word’s Fraction 8-K increases with 0.1 percentage...
points, the TRIR increases with 7.65%. Furthermore, if a company file a sustainability report, the TRIR increases with 15.7%. Finally, if Sentiment of Sustainability-Related Sentences in 10-K increases with 0.01, the TRIR increases with 11.7%. The additional adjusted R², gained by going from the control variables regression (8) to the multiple regression (7), is 0.8 percentage points. This positive development suggests that the additional information the textual variables give the model, outweighs the loss in efficiency. However, we conclude that we cannot reject the null hypothesis that the textual variables are not correlated with the TRIR after adjusting for firm- and time-fixed effects.

For the multiple regression (7) without time- and firm-fixed effects (Appendix 12.8), Relevant Word’s Fraction 10-K and Relevant Word’s Fraction 8-K are significantly different from zero. These variables lose significance after the inclusion of controls. Thus, we cannot neglect the possibility that their insignificance in the regression with control variables can be a result of consumed variation by the dummies. Regarding the variables Sustainability Report Dummy and Sentiment of Sustainability-Related Sentences in 10-K, these are insignificant in both the regressions with and without control variables. Therefore, our conclusion for these two is more solid.

The positive coefficient of Relevant Words' Fraction 10-K in regression (1) indicates that they write more about sustainability-related issues in the annual reports when the TRIR increases, and vice versa. If Relevant Words' Fraction 10-K increases with 0.1 percentage points, the TRIR increases with 5.0%, all else equal. Moreover, the coefficient is not significantly different from zero. Hence, we have statistical basis to conclude there is no correlation between the frequency of sustainability-related words in annual reports and the TRIR when time- and firm-fixed effects are adjusted for. However, when we compute regression (1) without time- and firm-fixed effects (Appendix 12.8), the coefficient is significantly different from zero. Thus, we cannot neglect that time- and firm specific effects consume the variation, and thus make Relevant Words' Fraction 10-K insignificant.

If Relevant Words' Fraction 8-K in regression (2) increases with 0.1 percentage points, the TRIR increases with 5.68%. The coefficient of Relevant Words' Fraction 8-K in regression (2) is not significant, implying we have the statistical foundation to conclude there is no correlation between the frequency of sustainability-related words in the 8-Ks and the TRIR. However, when we compute regression (2) without time- and firm-fixed effects (Appendix
12.8), the coefficient is significant. Hence, the firm and year dummies might consume variation in the variable, which can disguise whether the textual variable and TRIR actually are correlated.

The coefficient of Sustainability Report Dummy from regression (3) supports a positive correlation, which implies that if the companies publish a sustainability report, the TRIR increases. If a company file a sustainability report, the TRIR increases with 20.8 %, all else equal. In addition, the coefficient is significantly different from zero. Hence, we conclude there is correlation between publishing a sustainability report and their TRIR. However, when regression (3) is conducted without time- and firm-fixed effects (Appendix 12.8), the coefficient is not significant. This may indicate that initially, some variation in the excluded dummies is reflected in the Sustainability Report Dummy. When the time- and firm specific effects are included, the dummies might isolate a more valid correlation between the Sustainability Report Dummy and TRIR.

Furthermore, the coefficient of Sentiment of Sustainability-Related Sentences in 10-K in regression (4) indicates that if they write more positively about sustainability-related issues in their annual reports, the TRIR grows. If Sentiment of Sustainability-Related Sentences in 10-K increases with 0.01, the TRIR increases with 15.6 %. Moreover, the coefficient of Sentiment of Sustainability-Related Sentences in 10-K in regression (4) is significantly different from zero, which suggests that we can conclude there is correlation between the variable and the TRIR. However, for regression (4) without time- and firm-fixed effects (Appendix 12.8), the coefficient is not significant. Thus, we probably have a case of confounding, which means that the fixed effects are correlated with both TRIR and the Sustainability Report Dummy. When the dummies are included, they may reveal a more legitimate correlation between the Sustainability Report Dummy and TRIR.

The coefficient of Sentiment of Sustainability-Related Sentences in 8-K in regression (5) indicates a negative correlation, meaning that if they write more positively about sustainability-related issues in their event reports, the TRIR decreases. If Sentiment of Sustainability-Related Sentences in 8-K increases with 0.01, the TRIR decreases with 0.19 %. However, we can not reject the null hypothesis stating there is no correlation between the Sentiment of Sustainability-Related Sentences in 8-K and the TRIR. However, when we calculate regression (5) without time- and firm-fixed effects (Appendix 12.8), the coefficient
is significantly different from zero. Therefore, we cannot neglect that the dummies consume some of the variation. In addition, this regression also has relatively few observations. Thus, collinearity and missing observations might be an issue when determining whether the variable is correlated.

Regarding regression (6), the coefficient of Sentiment of Sustainability-Related Sentences in Sustainability Reports indicates a negative correlation. The negative correlation suggests that if they write more positively about sustainability-related issues in their sustainability reports, the TRIR decreases. If Sentiment of Sustainability-Related Sentences in Sustainability Reports increases with 0.01, the TRIR decreases with 1.45 %, all else equal. However, we can not reject the null hypothesis stating there is no correlation between the Sentiment of Sustainability-Related Sentences in Sustainability Reports and the TRIR. Moreover, in regression (6) without time- and firm-fixed effects (Appendix 12.8), the coefficient is not significantly different from zero. This suggests that collinearity is not an issue for whether the coefficient is correlated. Nevertheless, many missing observations reduces the credibility of our conclusion.
9. The Economic Dimension

GRI (2011) defines the economic dimension of sustainability as “the organization’s impacts on the economic conditions of its stakeholders, and on economic systems at local, national, and global levels”. In the same report, they describe the economic indicators as the “flow of capital among different stakeholders”, among others. By regarding government as a stakeholder, the environmental expenditures can be considered as a flow of capital between the firms and the government. Therefore, to represent the economic dimension of sustainability, we regard the environmental expenditures.

<table>
<thead>
<tr>
<th>Company</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Missing Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anadarko Petroleum Corp</td>
<td>99.08</td>
<td>32.39</td>
<td>0</td>
</tr>
<tr>
<td>Apache Corp</td>
<td>57.73</td>
<td>44.80</td>
<td>0</td>
</tr>
<tr>
<td>Chevron Corp</td>
<td>2525.00</td>
<td>691.67</td>
<td>0</td>
</tr>
<tr>
<td>ConocoPhillips</td>
<td>785.58</td>
<td>341.29</td>
<td>0</td>
</tr>
<tr>
<td>ExxonMobil Corp</td>
<td>4689.67</td>
<td>1139.97</td>
<td>0</td>
</tr>
<tr>
<td>Hess Corp</td>
<td>13.92</td>
<td>2.91</td>
<td>0</td>
</tr>
<tr>
<td>Marathon Oil Corp</td>
<td>677.57</td>
<td>129.71</td>
<td>5</td>
</tr>
<tr>
<td>Occidental Petroleum Corp</td>
<td>59.75</td>
<td>29.46</td>
<td>0</td>
</tr>
</tbody>
</table>

*Figure 14 - Descriptive Statistics of the Environmental Expenditures for the Years 2004 - 2015*

The range of the mean is 4675.75 million USD, which indicates large level differences between the firms. The only company with missing observations is Marathon Oil, with five values missing.

When we collect the environmental expenditures from the annual reports, we observe that the companies have deviating formulations. For instance, “accrued liabilities for remediation” (Marathon petroleum’s 10-K), “accrued environmental costs” (ConocoPhillips’ 10-K) and “reserve for estimated remediation liabilities” (Hess’ 10-K). These formulations are a concern if they include different measures when calculating the environmental expenditures. In addition, Polk (2009) states that: “environmental costs and liabilities can take various forms, the key facts are often difficult to ascertain and the underlying environmental laws (and their enforcement) are constantly changing”. This
implies that environmental expenditures are not clearly defined and can be subject to different interpretations, which in turn can explain the different wording used among the companies. To account for potential deviating interpretations, environmental expenditures is standardized by deducting the mean and dividing by the standard deviation, for each firm over time. Hence, the resulting variable will have a mean of zero and a standard deviation of one. Assuming that each company’s interpretation of the environmental expenditures remains constant, we have accounted for the different descriptions.

The figure above shows the standardized Environmental Expenditures versus the years 2004 - 2015. Visually, it is hard to comment on time- and firm-specific variation. Nevertheless, the funding of U.S. Environmental Protection Agency (EPA) over various years can yield year-specific variation. For instance, if EPA’s funding increases, more environmental incidents are addressed and hence the increase in the companies’ Environmental Expenditures (Savage, 2017). To remedy the issue with time-specific variation, we include year dummies in the regressions.

The standardization of Environmental Expenditures adjusts for deviations across firms in the dependent variable. However, it does not account for firm-specific differences in the independent variables. The written disclosure on sustainability may vary across firms due to
cultural differences, author’s writing style or deviating focus. Moreover, the plot in Appendix 12.10 indicates level differences between firms in the independent variables. Therefore, we cannot neglect that the differing focus across firms is reflected in the textual variables. Thus, we include firm dummies, since these also account for differences in the independent variables.

9.1 Results

Eleven year-specific dummy variables and seven firm-specific dummies are included in the following regressions. The potential consequences of adding dummies are addressed in the environmental dimension.

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Standardized Environmental Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Relevant Words’ Fraction 10-K</td>
<td>55.077</td>
</tr>
<tr>
<td></td>
<td>(125.728)</td>
</tr>
<tr>
<td>Relevant Words’ Fraction 8-K</td>
<td>-51.451</td>
</tr>
<tr>
<td></td>
<td>(223.767)</td>
</tr>
<tr>
<td>Sustainability Report Dummy</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.268)</td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 10-K</td>
<td>20.270</td>
</tr>
<tr>
<td></td>
<td>(20.571)</td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 8-K</td>
<td>-7.230</td>
</tr>
<tr>
<td></td>
<td>(5.328)</td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in Sustainability Reports</td>
<td>-35.481</td>
</tr>
<tr>
<td></td>
<td>(24.485)</td>
</tr>
<tr>
<td>Observations</td>
<td>91</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>-0.045</td>
</tr>
</tbody>
</table>

* p<0.1; ** p<0.05; *** p<0.01

Figure 16 - Regression Table for the Economic Dimension

Control variables are not shown in the regression table for readability purposes. The table consists of eight regressions in which the coefficients estimates of the textual variables are presented, significance level indicated by (*) and standard deviations in parentheses. We use a significance level of 10 %. The variables Sustainability-Related Sentences in 8-K and Sentiment of Sustainability-Related Sentences in Sustainability Reports are omitted from regression (7) on the same argumentation as in the other dimensions.

None of the coefficients in the multiple regression (7) are significantly different from zero. If Relevant Word’s Fraction 10-K increases with 0.1 percentage points, the Environmental Expenditures increases with 0.01 standard deviations, all else equal. If Relevant Word’s
Fraction 8-K increases with 0.1 percentage points, the Environmental Expenditures decreases with 0.02 standard deviations. Furthermore, if a company file a sustainability report, the Environmental Expenditures decreases with 0.07 standard deviations. Finally, if Sentiment of Sustainability-Related Sentences in 10-K increases with 0.01, the Environmental Expenditures increases with 0.2 standard deviations. The additional adjusted R², calculated by going from the control variables regression (8) to the multiple regression (7), is -4.5 percentage points. This negative development suggests that the additional information the textual variables give the model, does not outweigh the loss in efficiency. To conclude, we cannot reject the null hypothesis stating the textual variables are not correlated with the Environmental Expenditures after adjusting for firm- and time-fixed effects.

When we compute regression (7) without time- and firm-fixed effects (Appendix 12.9), only Relevant Words’ Fraction 10-K is significantly different from zero. This variable loses significance after the inclusion of controls. Therefore, we cannot neglect the possibility that its insignificance can be a result of consumed variation by the dummies. The variables Relevant Word’s Fraction 10-K, Relevant Word’s Fraction 8-K and Sustainability Report Dummy were insignificant in both the regressions with and without control variables. Hence, our conclusion of no significance for these variables is strengthened.

The coefficient of Relevant Words' Fraction 10-K in regression (1) indicates that when the companies write more about sustainability-related issues in the annual reports, the Environmental Expenditures increases, and vice versa. If Relevant Words' Fraction 10-K increases with 0.1 percentage points, the Environmental Expenditures increases with 0.06 standard deviations, all else equal. Nevertheless, the coefficient is not significant. Hence, we have the statistical basis to conclude there is no correlation between the frequency of sustainability-related words in annual reports and the Environmental Expenditures. However, when we calculate regression (1) without time- and firm-fixed effects (Appendix 12.9), the coefficient is significant. Thus, we cannot neglect that time- and firm specific effects consume variation, and thus makes Relevant Words' Fraction 10-K insignificant.

If Relevant Words’ Fraction 8-K in regression (2) increases with 0.1 percentage points, the Environmental Expenditures decreases 0.05 standard deviations, all else equal. The coefficient of Relevant Words' Fraction 8-K in regression (2) is not significant, implying we
have the statistical foundation to conclude there is no correlation between the frequency of sustainability-related words in the 8-Ks and the Environmenta...tional Expenditures. In addition, when we compute regression (2) without time- and firm-fixed effects (Appendix 12.9), the coefficient is also insignificant. Hence, our conclusion is more solid.

The coefficient of the variable Sustainability Report Dummy from regression (3) supports a negative correlation, implying that if they publish a sustainability report, their Environmental Expenditures decreases. If a company file a sustainability report, the Environmental Expenditures decreases with 0.006 standard deviations, all else equal. However, the coefficient is not significant. Hence, we have statistical foundation to conclude there is no correlation between publishing a sustainability report and their Environmental Expenditures. In addition, when regression (3) is conducted without time- and firm-fixed effects (Appendix 12.9), the coefficient is also insignificant, which strengthens the conclusion.

Furthermore, the coefficient of Sentiment of Sustainability-Related Sentences in 10-K in regression (4) indicates that if they write more positively about sustainability-related issues in their annual reports, the Environmental Expenditures grows. If Sentiment of Sustainability-Related Sentences in 10-K increases with 0.01, the Environmental Expenditures increases with 0.2 standard deviations. Moreover, the coefficient of Sentiment of Sustainability-Related Sentences in 10-K in regression (4) is not significantly different from zero, which suggests we have the statistical foundation to state there is no correlation between this variable and the Environmental Expenditures. Furthermore, when regression (4) is conducted without time- and firm-fixed effects (Appendix 12.9), the coefficient is also insignificant. Thus, the statement of no significance is more solid.

The coefficient of Sentiment of Sustainability-Related Sentences in 8-K in regression (5) indicates a negative correlation, meaning that if they write more positively about sustainability-related issues in their event reports, the Environmental Expenditures decreases. If Sentiment of Sustainability-Related Sentences in 8-K increases with 0.01, the Environmental Expenditures decreases with 0.07 standard deviations. However, we can not reject a null hypothesis stating there is no correlation between the Sentiment of Sustainability-Related Sentences in 8-K and the Environmental Expenditures. In addition, when computing regression (5) without time- and firm-fixed effects (Appendix 12.9), the
coefficient is also insignificant, which makes our conclusion more robust. Yet, relatively many missing observations may yield biased results, and thus make inference uncertain.

Regarding regression (6), the coefficient of Sentiment of Sustainability-Related Sentences in Sustainability Reports indicates a negative correlation. The negative correlation suggests that if they write more positively about sustainability-related issues in their sustainability reports, the Environmental Expenditures decreases. If Sentiment of Sustainability-Related Sentences in Sustainability Reports increases with 0.01, the Environmental Expenditures decreases with 0.35 standard deviations, all else equal. Finally, we cannot reject the null hypothesis, hence we have the statistical foundation to conclude that Sentiment of Sustainability-Related Sentences in Sustainability reports and the Environmental Expenditures are not correlated. In addition, when regression (6) is calculated without firm-and year specific effects, its coefficient is also insignificant, which strengthens our conclusion. Nevertheless, the relatively many missing observations reduces the credibility of our conclusion for this variable.
10. Final Thoughts

10.1 Conclusion

The goal of this thesis is to investigate how much the companies’ written disclosure on sustainability correlates with their performance regarding a sustainable development. All the three regressions with four textual variables have no correlation with the textual variables and the sustainability performance. Furthermore, in the environmental, social and economic dimension, the additional adjusted $R^2$ is -0.6 %, 0.8 % and -4.5 %, respectively. These arguments suggest that the textual variables combined can barely describe anything of the companies’ sustainability performance.

When analysing the textual variables individually in the environmental dimension, the only statistically significant coefficient is Sentiment of Sustainability-Related Sentences in Sustainability Reports. Regarding the social dimension, Sustainability Report Dummy and Sentiment of Sustainability-Related Sentences in 10-K are the only significant coefficients. In terms of the economic dimension, there are no significant coefficients. None of the frequency variables (Relevant Words’ Fraction in 10-K and Relevant Words’ Fraction in 8-K) are correlated with any of the sustainability performance indicators. Therefore, it appears that how much they write about sustainability correlates less with their performance compared to when they write positive or negative. Furthermore, considering that no variables derived from the 8-K reports are correlated with the performance indicators, we argue that these documents are not a suited reflection of the companies’ sustainability performance.

Whether the petroleum companies perform accordingly to their written disclosure raises the question of integrity. The border between hypocrisy and integrity is not clear, but a greyscale. While there are many limitations to our thesis, most of the results speaks in favor of our hypothesis. Thus, our findings indicate that the eight U.S. petroleum companies are tilted towards hypocrisy at the greyscale.
10.2 Limitations

The way we choose to measure the sustainability dimensions does not necessarily correspond with the companies’ efforts to address a sustainable development. For instance, if a given petroleum company choose to focus on the social dimension of sustainability by another performance indicator than TRIR, our results would not be accurate. If we had included more dependent variables, and conducted several regressions for each dimension, the sustainability performance could have been measured more precisely.

Moreover, there are several ways for a company to write about sustainability. The companies can communicate their written sustainability disclosure through other channels than the documents investigated in this thesis. Examples are the companies’ websites, quarterly reports or other documents. Therefore, it is perhaps insufficient to analyse the 10-Ks, 8-Ks and sustainability reports alone.

Regarding the Relevant Words Vector, one can argue that it would have been more precise to create a relevant words vector for each dimension of sustainability. For instance, to have a relevant words vector containing words related to the social dimension exclusively, and used this for the regression with TRIR as dependent variable. Doing this for all dimensions, the textual variables of the three different regressions could be more specific for their respective dependent variable. Thus, the variables could possibly explain more of the sustainability performance. However, this would have been difficult. The potential three relevant words vectors would have been constituted by even fewer words, and thus yielded even more missing values. Moreover, some words are used in different contexts between the documents we investigate, and to create a relevant words vector for each document type can improve the results. However, to make relevant words vectors that are document- and dimension specific would have required 9 vectors, which will increase the complexity of our approach greatly. In addition, since we also use a qualitative approach when choosing the relevant words, our subjective opinion regarding sustainability may fail to reflect how the reports address sustainability.

Furthermore, our sentiment analysis is also subject to shortcomings. It is uncertain that the Harvard IV dictionary give a precise quantitative measure of their sustainability sentiment.
Furthermore, taking the netto sentiment and dividing the score by the amount of words in the respective document is not necessarily beneficial for small documents. For instance, this approach can yield unreasonably high positive or negative sentiment scores if there are few relevant sentences. In our case, the sentiment of the 8-Ks, which sometimes have a small number of sustainability-related sentences, can be subject to relatively high absolute values.

As regards measurement errors, the sustainability performance indicators TRIR and environmental expenditures are uncertain. The reports often disclose performance indicators for a 4-5 years period back. The result is that a performance indicator for a given year can be found in several reports. Hence, the ambiguity, since a performance indicator for a given year in a given report can be different in another report. To remedy the issue, we choose to regard the performance indicators from the newest reports. In so doing, potential hindsight changes by the petroleum companies in the indicators is accounted for. However, it does not eliminate the issue of measurement errors completely.

10.3 Future Work

The scope of our thesis can be adjusted to make it applicable for several industries, such as the car or coal industry. A possible modification in the scope of sustainability is to narrow down the analysis to solely investigate greenhouse gas emissions. In so doing, the data foundation for the dependent variable can be expanded significantly. Moreover, our thesis focuses on the companies’ negative externalities. It can be interesting to include performance indicators related to positive externalities as well. How do companies make a positive impact on the world? And how do they write and promote that impact?
11. References


Barkemeyer, R., Comyns, B., Figge, F., & Napolitano, G. (2014). CEO statements in sustainability reports: Substantive information or background noise?


12. Appendices

12.1 Comparison of 10-K, 8-K and Sustainability Reports

```r
### SCRIPT TO COMPARE THE DIFFERENT SOURCES ###

# Acquiring the data
load("/Users/theodor_dokkan/Documents/Dokumenter/NHH/Master/Masteroppgave/Dataobjekter/10 K data/sus.pdf.Rdata")
load("/Users/theodor_dokkan/Documents/Dokumenter/NHH/Master/Masteroppgave/Dataobjekter/8 K data/k8.Rdata")
load("/Users/theodor_dokkan/Documents/Dokumenter/NHH/Master/Masteroppgave/Dataobjekter/10 K data/k10 (1).Rdata")

# Requiring packages
require(tm)

## Loading required package: tm

## Warning: package 'tm' was built under R version 3.4.3

## Loading required package: NLP

## FALSE  TRUE
## 75  25

# Making a dtm of the k8
corpus.sus <- Corpus(VectorSource(sus.pdf))
dtm.sus <- TermDocumentMatrix(corpus.sus, control = list(removePunctuation = TRUE,
                                     stopwords = TRUE,
                                     removeNumbers = TRUE,
                                     wordLengths = c(2, 200),
                                     tolower = TRUE))

# Converting SUS to a matrix
sus.mat <- as.matrix(dtm.sus)
sus.freq <- rowSums(sus.mat)
sus.freq <- sort(sus.freq, decreasing = TRUE)
sus.freq <- sus.freq[1:100]

# Comparing how equal sus is to 8K
table(names(sus.freq) == names(k8.freq))

## FALSE  TRUE
## 87  13
Initially, the raw data is loaded. The first, second and third vector contains sustainability reports, 8-K reports and 10-K reports as vector elements, respectively. Next, the required packages to conduct the analysis is acquired. We subsequently create a term document matrix of the 10-K reports. A term document matrix has the different documents as one dimension, and the various terms in the other dimension. The inputs are naturally the term frequencies in the various documents. Moreover, the row sums of the term document matrix are calculated and made into a vector. Thus, the vector contains all the different terms’ frequency in all the 10-K reports combined. This frequency vector is sorted in a decreasing order and trimmed so that only the 100 most frequent terms are shown.

The exact same approach is applied for the 8-K reports to create an equivalent frequency vector. In order to compare the similarities between the 8-K’s and 10-K’s, we investigate how many terms these two vectors have in common and create a table of the results. The vectors have 25 common words. A frequency vector for the sustainability reports is also created. When we compare the similarity to the 8-K’s, we find that the two vectors have 13 common words. Thus, the data supports a higher degree of similarity between the 8-K’s and the 10-K’s.
12.2 Relevant Words Vector

The code first finds the most common words using the same procedure as explained in Appendix 12.1. An issue with this frequency vector is that inflected forms of the words often occur within the frequent words list. For example, “environment”, “environments” and “environmental”, or “community” and “communities”. These words mean essentially the same but can be displayed as different words in the frequent words vector. Hence, similar words are combined into one vector and the shortest form of the word is kept. The final result is the following vector of the most frequent words in the sustainability reports:

```
dev
velop  report  operation  employee  environment  business  company  manage  safety  energy
6527  5966  5773  5659  5589  5419  5384  5143  4994  4983

ommon  program  water  emission  project  process  product  percent  performance  local
4644  4595  4211  4198  3927  3823  3810  3026  3952  3126

global  health  million  provide  corporate  improve  training  include  right  national
2934  2929  2877  2768  2738  2669  2560  2533  2581  2405

industry  human  social  source  support  supply  impact  stakeholder  state  system
2489  2471  2403  2381  2383  2289  2259  2178  2137  2135

issue  contract  policy  world  including  ability  natural  standard  operate  continue
2884  2883  2608  2811  1922  1920  1514  1880  1829  1829

activity  reduce  conduct  assess  technology  country  change  spill  implement  workforce
1797  1746  1743  1786  1786  1688  1653  1551  1647  1647

facility  incident  economic  partner  government  opportunity  total  asset  information  based
1646  1628  1600  1574  1562  1562  1598  1598  1598  1598

addition initiative  climate  increase  security  direct  diversity  engagement  risks  focus
1498  1487  1459  1418  1416  1485  1398  1394  1394  1374

practices effort commitment  carbon  education  identify  level  united  investment  responsibility
1399  1333  1389  1385  1381  1299  1299  1294  1291  1288

value  action  result  potential  approach  sustainable  areas  metric  protect  group
1285  1276  1251  1225  1225  1211  1192  1189  1184  1183

group  leaders  review  years  approximately  address  build  people  public  response
1183  1180  1147  1144  1117  1116  1110  1108  1106  1096

significant  related  women  working  efficiency  strategy  board  north  ensure  place
1096  1083  1083  1083  1082  1082  998  996  993  984  979

petroleum  plans  annual  operating  services  waste  compliance  understand  market  share
977  951  940  934  932  929  928  927  926  925  925

reduction  number  principles  member  greenhouse  future  citizenship  challenge  design  drilling
916  909  899  889  888  889  860  861  860  857  845

field  organizations  since  effective  benefit  first  requirements  chemical  guineas  research
843  839  826  826  826  821  816  815  814  813  813

integration  across  corporation  responsible  exploration  association  school  america  study  growth
792  789  788  773  765  739  737  746  745  745  745

voluntary  quality  governance  early  major  enhance  needs  committee  example  produced
688  683  681  680  678  675  669  665  665  664  664

managing  expectations  current  learn  around  within  large  barrels  interest  material
656  654  653  653  652  650  650  649  649  649  649

internal  tonnes  equatorial  participate  organization  transparency  technical  emergency  billion  political
639  636  634  633  631  630  629  628  627  621  621

Figure 17 - The Most Frequent Words in the Sustainability Reports
Note that a few words are still in their inflected forms in this vector due to very low frequency of the indefinite form of the word. This is due to the initial cleaning of the vector, which removes words with less than 200 in frequency. The script has its limitations by for example not being able to handle “ing”-endings, and two places within the 200 most frequent words it has captured a word without meaning, “ipyca” and “fyld”.

12.3 Marathon Oil

TRIR.Pop is the annual mean TRIR across all firms except Marathon Oil, while TRIR.Marathon is the TRIR for Marathon Oil.

![Shapiro-Wilk normality test](image1.png)

The test yields that we can not reject a null hypothesis stating the two populations are normally distributed. Therefore, an F-test can be conducted to investigate whether there is a difference in variation between the two populations.

![F test to compare two variances](image2.png)

The result indicates that we can not reject the null hypothesis for no differences in variation between the two populations. Thus, the tests yield that there is no potential problem of deviating variances, and Marathon Oil can be included without further issues.
12.4 Greenhouse Gas Emissions

Both tests for normal distribution of GHG rejects null hypothesis that the variable is normally distributed.
12.5 Total Recordable Incident Rate

We see from the level plot and the Shapiro-Wilk normality test of TRIR that we can reject the null hypothesis of a normal distribution. After logging, the log(TRIR) plot indicates a normal distribution and the corresponding normality test states that we can not reject a null hypothesis of a normal distribution.

Figure 21 - Normality Test for TRIR
12.6 Standardized Environmental Expenditures

The results indicate that we cannot reject the null hypothesis of a normal distribution of the level standardized environmental expenditures, while we can reject a normal distribution when logging the variable.
12.7 Greenhouse Gas Emission Rate without Time- and Firm-Fixed Effects

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>ln(Greenhouse Gas Emissions/Production)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Relevant Words' Fraction 10-K</td>
<td>-10.452**</td>
</tr>
<tr>
<td></td>
<td>(4.819)</td>
</tr>
<tr>
<td>Relevant Words' Fraction 8-K</td>
<td>6.210</td>
</tr>
<tr>
<td></td>
<td>(12.080)</td>
</tr>
<tr>
<td>Sustainability Report Dummy</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 10-K</td>
<td>-1.520**</td>
</tr>
<tr>
<td></td>
<td>(0.598)</td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 8-K</td>
<td>0.403</td>
</tr>
<tr>
<td></td>
<td>(0.271)</td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in Sustainability Reports</td>
<td>-2.664*</td>
</tr>
<tr>
<td></td>
<td>(1.353)</td>
</tr>
<tr>
<td>Observations</td>
<td>96</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.038</td>
</tr>
</tbody>
</table>

*Note:  *p<0.1; **p<0.05; ***p<0.01

*Figure 23 - Greenhouse Gas Emission Rate without Time- and Firm-Fixed Effects*
12.8 Total Recordable Incident Rate without Time- and Firm-Fixed Effects

<table>
<thead>
<tr>
<th>Dependent variable: ln(Total Recordable Incident Rate)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant Words’ Fraction 10-K</td>
<td>-199.297***</td>
<td>-161.578***</td>
<td>(55.223)</td>
<td>(51.814)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant Words’ Fraction 8-K</td>
<td>-496.986***</td>
<td>-303.783***</td>
<td>(123.046)</td>
<td>(124.274)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Report Dummy</td>
<td>-0.237</td>
<td>-0.109</td>
<td>(0.191)</td>
<td>(0.170)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 10-K</td>
<td>-2.136</td>
<td>-8.351</td>
<td>(7.280)</td>
<td>(6.847)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 8-K</td>
<td>8.398***</td>
<td></td>
<td>(2.353)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in Sustainability Reports</td>
<td></td>
<td>-6.559</td>
<td>(17.386)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Observations                                         | 79        | 79        | 79        | 79        | 39        | 55        | 79        |
| Adjusted R²                                           | 0.134     | 0.164     | 0.007     | -0.012    | 0.236     | -0.016    | 0.271     |

* p<0.1; ** p<0.05; *** p<0.01

*Figure 24 - Total Recordable Incident Rate without Time- and Firm-Fixed Effects*
12.9 Standardized Environmental Expenditures without Time- and Firm-Fixed Effects

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Standardized Environmental Expenditures</th>
<th>( (1) )</th>
<th>( (2) )</th>
<th>( (3) )</th>
<th>( (4) )</th>
<th>( (5) )</th>
<th>( (6) )</th>
<th>( (7) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant Words’ Fraction 10-K</td>
<td>139.405**</td>
<td>( (65.043) )</td>
<td>125.607*</td>
<td>( (69.437) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant Words’ Fraction 8-K</td>
<td>192.399</td>
<td>( (160.788) )</td>
<td>66.727</td>
<td>( (171.352) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Report Dummy</td>
<td>0.290</td>
<td>( (0.202) )</td>
<td>0.235</td>
<td>( (0.211) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 10-K</td>
<td>-4.775</td>
<td>( (8.222) )</td>
<td>-8.182</td>
<td>( (8.738) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentiment of Sustainability-Related Sentences in 8-K</td>
<td>-2.385</td>
<td>( (2.931) )</td>
<td>-21.007</td>
<td>( (20.305) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations: 91, Adjusted R\(^2\): 0.038

*\( p<0.1; ** p<0.05; *** p<0.01 \)

Figure 25 - Standardized Environmental Expenditures without Time- and Firm-Fixed Effects
12.10 Level Differences in the Independent Variables

Figure 26 - Level Differences in Sentiment of Sustainability-Related Sentences 10-K

Figure 27 - Level Differences in Relevant Words’ Fraction 10-K
12.11 Control Variables in the Environmental Dimension

Call:
\[ \text{lm(formula = df$GHG} \sim \text{df$Year + df$Firm)} \]

Residuals:

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>1Q</th>
<th>Median</th>
<th>3Q</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.163588</td>
<td>-0.032463</td>
<td>0.009753</td>
<td>0.036292</td>
<td>0.188346</td>
</tr>
</tbody>
</table>

Coefficients:

|                  | Estimate | Std. Error | t value | \( \text{Pr(>|t|)} \) |
|------------------|----------|------------|---------|----------------------|
| (Intercept)      | 0.4362423| 0.0271746  | 16.053  | < 2e-16 ***          |
| df$Year2005      | 0.0110065| 0.0305416  | 0.363   | 0.71736               |
| df$Year2006      | -0.0595118| 0.0305416 | -1.949  | 0.05499 *             |
| df$Year2007      | -0.0386176| 0.0305416 | -1.264  | 0.20892               |
| df$Year2008      | -0.0340288| 0.0305416 | -1.114  | 0.26867               |
| df$Year2009      | -0.0238637| 0.0305416 | -0.781  | 0.43699               |
| df$Year2010      | -0.0180884| 0.0305416 | -0.592  | 0.55541               |
| df$Year2011      | -0.0394549| 0.0305416 | -1.292  | 0.20028               |
| df$Year2012      | -0.0339315| 0.0305416 | -1.111  | 0.27003               |
| df$Year2013      | -0.0373037| 0.0305416 | -1.221  | 0.22566               |
| df$Year2014      | -0.0636784| 0.0305416 | -2.085  | 0.04039 *             |
| df$Year2015      | -0.0900776| 0.0305416 | -2.949  | 0.00422 **            |
| df$FirmApache Corp| 0.1064931| 0.0249371 | 4.270   | 5.51e-05 ***          |
| df$FirmChevron Corp| 0.0077232| 0.0249371 | 0.310   | 0.75762               |
| df$FirmConocoPhillips| 0.0811439| 0.0249371 | 3.254   | 0.00169 **            |
| df$FirmExxonMobil Corp| -0.0005278| 0.0249371 | -0.021  | 0.98317               |
| df$FirmHess Corp| -0.0029911| 0.0249371 | -0.120  | 0.90484               |
| df$FirmMarathon Oil Corp| 0.0065671| 0.0249371 | 0.263   | 0.79299               |
| df$FirmOccidental Petroleum Corp| 0.0429241| 0.0249371 | 1.721   | 0.08921               |

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Figure 28 - Control Variables in the Environmental Dimension
12.12 Control Variables in the Social Dimension

Call:
\texttt{lm(formula = dfSTRIR ~ df$Firm + df$Year)}

Residuals:

\begin{tabular}{cccccc}
Min & 1Q & Median & 3Q & Max \\
-1.14589 & -0.16975 & 0.03239 & 0.18464 & 0.58479 \\
\end{tabular}

Coefficients:

\begin{tabular}{lrrrr}
  & Estimate & Std. Error & t value & Pr(>|t|) \\
(Intercept) & 0.14270 & 0.23087 & 0.618 & 0.53885 \\
df$FirmApache Corp & 1.00105 & 0.16371 & 6.115 & 7.89e-08 *** \\
df$FirmChevron Corp & -0.85194 & 0.15338 & -5.555 & 6.72e-07 *** \\
df$FirmConocoPhillips & -1.26894 & 0.16371 & -7.751 & 1.30e-10 *** \\
df$FirmExxonMobil Corp & -0.67594 & 0.15338 & -4.407 & 4.40e-05 *** \\
df$FirmHess Corp & 0.15636 & 0.15338 & 1.019 & 0.31207 \\
df$FirmMarathon Oil Corp & 0.28778 & 0.16003 & 1.798 & 0.07716 . \\
df$FirmOccidental Petroleum Corp & -0.25073 & 0.15721 & -1.595 & 0.11600 \\
df$Year2008 & -0.09255 & 0.26733 & -0.346 & 0.73041 \\
df$Year2009 & -0.33573 & 0.25185 & -1.333 & 0.18754 \\
df$Year2010 & -0.37207 & 0.24220 & -1.536 & 0.12975 \\
df$Year2011 & -0.47744 & 0.22722 & -2.101 & 0.03983 * \\
df$Year2012 & -0.67810 & 0.22722 & -2.984 & 0.00411 ** \\
df$Year2013 & -0.75594 & 0.22722 & -3.327 & 0.00150 ** \\
df$Year2014 & -0.90732 & 0.22722 & -3.993 & 0.00018 *** \\
df$Year2015 & -1.11929 & 0.22722 & -4.926 & 6.92e-06 *** \\
df$Year2016 & -1.22983 & 0.22722 & -5.413 & 1.15e-06 *** \\
df$Year2017 & -1.25642 & 0.22722 & -5.530 & 7.38e-07 *** \\
df$Year2018 & -1.32278 & 0.22722 & -5.822 & 2.43e-07 *** \\
\end{tabular}

---

Signif. codes: \texttt{0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1}

\textit{Figure 29 - Control Variables in the Social Dimension}
12.13 Control Variables in the Economic Dimension

Call:
`lm(formula = df$N.ECO ~ df$Year + df$Firm)`

Residuals:

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>1Q</th>
<th>Median</th>
<th>3Q</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1.89778</td>
<td>-0.73645</td>
<td>0.04104</td>
<td>0.67802</td>
<td>1.62995</td>
</tr>
</tbody>
</table>

Coefficients:

|                  | Estimate | Std. Error | t value | Pr(>|t|) |
|------------------|----------|------------|---------|---------|
| (Intercept)      | -8.175e-01 | 4.354e-01  | -1.878  | 0.0645  |
| df$Year2005      | 2.030e-01  | 4.880e-01  | 0.416   | 0.6787  |
| df$Year2006      | 3.340e-01  | 4.880e-01  | 0.684   | 0.4959  |
| df$Year2007      | 7.915e-01  | 4.880e-01  | 1.622   | 0.1092  |
| df$Year2008      | 8.944e-01  | 4.880e-01  | 1.833   | 0.0710  |
| df$Year2009      | 8.414e-01  | 4.880e-01  | 1.724   | 0.0890  |
| df$Year2010      | 1.007e+00  | 4.880e-01  | 2.064   | 0.0426  *|
| df$Year2011      | 1.315e+00  | 5.075e-01  | 2.590   | 0.0116  *|
| df$Year2012      | 1.100e+00  | 5.075e-01  | 2.168   | 0.0335  *|
| df$Year2013      | 1.171e+00  | 5.075e-01  | 2.307   | 0.0239  *|
| df$Year2014      | 9.833e-01  | 5.075e-01  | 1.938   | 0.0566  |
| df$Year2015      | 1.169e+00  | 5.075e-01  | 2.304   | 0.0241  *|
| df$FirmApache Corp | -6.942e-16 | 3.984e-01  | 0.000   | 1.0000  |
| df$FirmChevron Corp | -5.830e-16 | 3.984e-01  | 0.000   | 1.0000  |
| df$FirmConocoPhillips | -6.774e-16 | 3.984e-01  | 0.000   | 1.0000  |
| df$FirmExxonMobil Corp | -7.481e-16 | 3.984e-01  | 0.000   | 1.0000  |
| df$FirmHess Corp | -4.821e-16  | 3.984e-01  | 0.000   | 1.0000  |
| df$FirmMarathon Oil Corp | 2.359e-01  | 4.728e-01  | 0.499   | 0.6194  |
| df$FirmOccidental Petroleum Corp | -6.345e-16 | 3.984e-01  | 0.000   | 1.0000  |

---

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

*Figure 30 - Control Variables in the Economic Dimension*