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Environmental effects on shareholder value through oil and gas divestitures following the Paris Agreement

An event study on environmental commitments, performance and greenwashing by divesting oil and gas companies globally

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ABSTRACT

This study investigates the potential impact of company environmental factors including commitments, performance and greenwashing on abnormal returns surrounding sell-off announcements by global oil and gas companies. The sample consists of 172 divestitures of at least $150 million in the years 2017 until 2021. No persistent effects on value creation are found regarding either the number of environmental commitments (out of four selected by the Environmental Defense Fund) as well as environmental performance as measured by the use of divestiture proceeds and, separately, an external performance score provided by the World Benchmarking Alliance. The constructed greenwashing coefficients based on the differences between these commitments and actual performance similarly show no relation with divestiture announcement returns, measured through three-day CARs.

Keywords: Event study, divestitures, emissions, greenwashing, environmental commitments

JEL Classification: G14, G30, G34, Q51

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CHAPTER 1 Introduction

The oil and gas sector has recently embarked on a large wave of divestitures. Companies are aiming to reshape their portfolios for the energy transition, freeing up cash that could be used to invest in renewables, pay dividends to shareholders or strengthen their core positions, according to Guldbrandsøy and Haarmann (2020) of energy research firm Rystad Energy. The authors projected in October of 2020 that the world's largest oil and gas companies including Shell, ExxonMobil and BP would sell oil and gas assets worth a combined $100 billion over the coming years. They expected the biggest petroleum companies to mainly divest assets with the highest carbon emission intensities and concentrate oil and gas production on countries where this is cheapest and easiest to do. Following the Paris Agreement which came into effect in November 2016, a rise in divestitures by oil and gas companies already started in 2017. Shell disposed of more than $16 billion in upstream assets in that year, being the first oil and gas major to start transformation into a low-carbon energy company (Raval, 2021; Dietz et al., 2020). Pickl (2019) in an analysis of the industry also argues that oil majors have started their journey from big oil towards big (renewable) energy, and in 2021 alone, $192 billion in upstream oil and gas assets changed hands (EDF, 2022). Given the expected large sell-off in the coming years, it is of interest to study the (preliminary) effects of this industry shift in terms of shareholder value. This study especially focuses on whether the market differentiates between environmental commitments, actual environmental performance, and the difference between these two as a proxy for greenwashing. This leads to the following research question:

What impact do companies' environmental commitments, performance and degree of greenwashing have on value creation through sell-offs by oil and gas companies following the Paris Agreement?

One example of a firm that has successfully repositioned itself for the energy transition, away from fossil fuel into renewables, is the Danish firm Ørsted. The firm decided in 2016 to divest its complete portfolio of oil and gas activities in order to focus entirely on energy production from renewable sources. Today, it is the largest offshore wind energy producer on the planet, having combined the significant reduction in carbon emissions per sold energy quantity with an improvement of net results (Van Egmond & Doeswijk, 2022). The authors argue that a positive value impact can be expected from divestitures of polluting assets by oil and gas companies in the long run, but a study on the topic has yet to be done.

Painting a less positive picture, Blackrock CEO Larry Fink recently argued that these divestitures are merely a form of greenwashing, as the assets change ownership but maintain in existence, leaving pollution unchanged at best (Handley, 2021). Greenwashing is defined by the Cambridge Dictionary (2023) as "behaviour or activities that make people believe that a company is doing more to protect the environment than it really is". Due to shareholder pressure, these assets are often transferred to private owners or other companies having much lower levels of disclosure on emissions. These divestitures do therefore not contribute toward limiting global warming and leave society in a worse position than before (Handley, 2021). This thesis aims to investigate the environmental disclosure and performance impact of these divestitures and their relation with corresponding returns to the parent companies' shareholders.

Analysis by S&P Global shows that among the top thirty oil and gas companies, 70% have made net-zero pledges at or before the end of 2021. This pledge implies that overall carbon emissions from their operations and supply chains, named Scope 1 and Scope 2 emissions, are at maximum zero by 2050. Although these pledges are initiated to create alignment with the Paris Agreement to limit global warming to less than two degrees Celsius by 2050, the analysis shows that the sector is on track to contribute to a rise of more than five degrees in global temperature until 2025 (Holland and Dlin, 2021). In an April 2021 report, Swiss Re, one of the largest reinsurance providers, estimated that the effects of climate change are on track to reduce global economic output by 11 to 14 percent by 2050, equivalent to $23 trillion. Developing countries such as Malaysia, the Philippines and Thailand with the current progress would experience economic growth 20 percent below what they could otherwise expect, whereas a 3.2-degree scenario would diminish the size of their economy by half in 2050. Contrastingly, the report shows economic losses would be marginal when succeeding to keep global warming below two degrees (Flavelle, 2021). U.S. Deputy Energy Secretary David Turk said last December at the World Petroleum Congress in Houston that it is up to the world's largest oil and gas companies to embrace the energy transition, invest in cleaner alternatives and either profit as a result or face financial failure otherwise. He emphasized that the only path to success involves major companies to step up and be part of the solution (Holland and Dlin, 2021). Divestment, consequently, is not sufficient to reach this two-degree goal.

Aside from assessing the overall divestiture announcement returns, this paper looks into a potential relationship between these returns and the divesting company's prior environmental commitments and separately their actual environmental performance, as measured by the uses of the divestiture proceeds as well as a company environmental performance score provided by the World Benchmarking Alliance (WBA). Additionally, I create two separate greenwashing coefficients based on the difference between divesting firms' stated environmental commitments and actual performance and test these for value effects using the event study methodology. Furthermore, it investigates whether more polluting assets move relatively more often towards companies with lower environmental commitments, and whether divestitures that are acquired by these companies earn higher announcement returns due to potential arbitrage arising from environmental pressure.

The results of this study provide little to no evidence for any effect of environment related factors on the announcement returns of divestitures. The amount of environmental commitments, as well as the level of environmental performance as measured by the uses of divestiture proceeds and the WBA performance score show no significant relation with these returns. Only when transforming the announcement returns in a binary variable for positive value creation, a strong negative association appears between stating to invest the proceeds in a ‘green’ versus ‘neutral’ labelled category and the likelihood of obtaining a positive CAR. The same is found for an increase in the emissions intensity of the divested asset. This is in line with highly emitting divestitures earning a lower disposal value, versus a market favoring ‘neutral’ uses including dividend payments over green investments by divesting oil and gas firms. The market does not seem to punish or reward firms that perform better (or worse) than might be expected from their commitments, which is the basis for this study’s greenwashing coefficients. Furthermore, with 68.6 percent of the divestitures, a large majority of assets move to either companies with a lower level of environmental commitments, or private owners. It can however not be confirmed that more polluting assets move to private companies more often. Lastly, divestitures moving to private companies combined with those reducing the environmental commitments earn similar announcement returns to the more ‘reporting-friendly’ transactions. The market conclusively seems not to systematically differentiate on any of the included environmental factors with regard to divestitures, possibly due to a lack of reliable information and comparability between firms. However, the methodologies used in this study are likely not sufficient to draw any definitive conclusions, as research on the topic is still in its early stages and requires further study.

This thesis is structured as follows: chapter 2 provides an overview of the relevant literature, chapters 3 and 4 describe the data and methodology used, chapter 5 provides the results and chapter 6 concludes the results along with limitations of this study and future recommended research.

CHAPTER 2 Literature Review

The origin of divestiture research lies in the 1980s, as divestitures increased significantly in both volume and size in that decade. This can be attributed to two major trends: First, managers became increasingly disciplined by the growing market for corporate control, which constricted information advantages of diversified firms' internal capital markets. Second, negative evidence from research caused capital markets to become highly critical toward diversified conglomerates. This led firms to reverse more acquisitions through divestitures than the amount that they maintained (Brauer, 2006). It is of importance to understand the previously found determinants of divestitures and the effects on firm value, but also the value implications of environmental factors.

2.1 Determinants of divestitures

Previous literature suggests that managers are often reluctant to divest part of their business. A possible explanation is that divestitures might send a signal of failure or weakness. Other argumentations include the fear of decreasing economies of scale, negative analyst coverage effects, damaged employee morale and the acknowledgement of sunk costs (Huyett and Koller, 2011). Teschner and Paul (2021) state that the causes underlying the avoidance of divestitures are often related to psychological biases, such as the sunk cost fallacy. These biases lead managers to have unrealistically positive expectations about future improvements in performance. Kolev (2015) mentions managers wanting to avoid a reduction in firm size and managerial compensation among rational arguments not to divest. According to Teschner and Paul (2021), managers often only divest assets due to strong outside pressure, coming from e.g., heavy losses or high debt burdens. To understand the observed drivers of divestiture returns and isolate the effects of interest in this study, it is important to understand the main determinants of divestiture activity. Kolev (2015) has categorized the findings of 35 studies on the subject into four broad categories: corporate governance, firm strategy, performance and industry environment. The subsections below discuss each of these determinants.

2.1.1 Corporate governance determinants

The relationship between corporate governance factors and divestiture behavior is based on agency theory. Jensen and Meckling (1976) proposed this theory, which revolves around the conflict of interests between managers and shareholders. Managers' personal interests could result in actions increasing their own wealth at the expense of shareholders and, specifically, might make them reluctant to undertake value enhancing divestitures. Corporate governance mechanisms designed to overcome these conflicts can therefore increase the likelihood of managers engaging in divestitures. Kolev (2015) details four such mechanisms: boards of directors, the presence of large external shareholders, the absence of CEO-chairman duality and managerial equity.

The first three factors relate to the monitoring of executives, which increases the likelihood of them engaging in activities beneficial to shareholders. One major aspect of the effectiveness of boards is the level of independency of its directors, as independent boards are more likely to challenge the CEO and represent shareholders' interests (Kroll et al., 2008). Similarly, Kolev (2015) argues that the presence of a large shareholder and no CEO-chairman duality should increase the likelihood of a CEO pursuing divestitures, although the aggregated studies he summarizes find no significant effects for these variables. Lastly, the author finds that managerial equity reduces their propensity to divest. Although managers' incentives are more aligned with those of shareholders through equity ownership, he attributes this effect to prior research connecting this ownership to managers' identification with the firm, generating non-economic benefits due to which they are reluctant to divest part of the business (Ashforth and Mael, 1989).

2.1.2 Firm strategy determinants

A firm's structural characteristics and accumulated experiences have a great impact on the implementation decisions of important strategic activities such as divestitures, according to Kolev (2015). In his meta-analysis of 35 prior studies, he finds the level of diversification, firm size and the number of prior divestitures to positively affect subsequent divestiture activity. The diversification effect is explained through the reversal of the previously researched diversification discount and the increased ease by which a division can be disposed of for diversified firms (Berger and Ofek, 1995). Larger firm size is associated with higher levels of complexity, which creates inefficiencies in managing the firm and can undermine corporate control. Additionally, larger size can lead to tunnel vision, causing managers to divest assets (Miller and Chen, 1994; Decker and Mellewigt, 2012). Prior divestitures influence the propensity to divest because firms often experience positive wealth effects and therefore increase managers' confidence in implementing divestitures. Once becoming familiar with the process of divesting, this can enter the organization's routine (Kolev, 2015).

2.1.3 Performance determinants

Both firm and unit performance prior to divestitures have received significant attention in divestiture research. Poor performance has been argued to stem from organizational inefficiencies, which can subsequently be reduced through divestitures (Johnson, 1996). According to the behavioral theory of the firm, poor performance can additionally cause dissatisfaction with management about the current organization and incline managers to initiate changes, amongst others through divestitures (Cyert and March, 1963). Although often hypothesized to be a determinant of divestiture activity, Kolev (2015) finds no effect of prior firm performance. He offers as a potential explanation that it is difficult for managers to exactly identify the source of the losses when the company as a whole is performing badly. Poor performance at the unit level, however, does significantly increase the probability of the unit being divested. This suggests that managers do make adequate decisions to divest poorly performing units and maintain the well performing ones. Another factor through which performance influences divestiture activity is the availability of slack resources. As well performing firms often generate strong cash flows, additional resources can be set aside. Managers are subsequently less inclined to change the organizational structure. Contrastingly, when these resources are depleted, managers are found to raise additional resources through various actions, amongst which divestitures (Palmer and Wiseman, 1999; Kolev, 2015).

2.1.4 Industry environment determinants

Özgür and Wirl (2020) find that industry-specific factors have been much more important in determining oil and gas M&A activity in this century than familiar and researched economic conditions. Therefore arguably the most important driving factor for current divestitures in the oil and gas sector, industry characteristics influence how much a firm needs to adapt to the environmental context through organizational change. Bain (1960) and Porter (1980) have laid the groundwork for this perspective through the theory of industrial organization economics, which examines how industry conditions affect firms' strategy and actions. Unfavorable industry conditions such as uncertainty and low environmental munificence (the availability of resources and environmental ability to support growth) should drive more divestitures according to this theory (Kolev, 2015). However, the author finds no support for these environmental factors driving divestitures, reasoning that managers focus more on internal firm factors over which they have greater control. Nonetheless, other corporate environmental factors such as important industry (demand) shifts as is the case with the oil and gas industry during the energy transition, are left out of consideration in this study.

Brauer and Wiersema (2012) investigated the temporal position of firms in an industry divestiture wave, arguing that it reveals information about potential imitation by managers of industry peers. They find that the position influences stock market returns in a U-shaped pattern, where divestitures in the midst of a divestiture wave generate the lowest announcement returns. The authors reason that investors assess the quality of managements' decisions and its performance consequences to be lower due to a higher degree of imitation of their peers.

2.2 Divestiture effects on shareholder value

2.2.1 Divestiture announcement returns

In line with positive effects found on post-divestiture firm performance, research on the value effects of voluntary divestments has found significant positive abnormal returns around the divestiture announcement date (Lee and Madhavan, 2010). This is both the case for spin-offs, where a separate publicly traded company is created and all the common stock owned by the firm is distributed to its shareholders, as well as for sell-offs, where the business unit is purchased by another firm and ownership is transferred (Rosenfeld, 1984). In Rosenfeld's study, average abnormal returns (AAR) on the announcement date are found to be 4.57% for spin-offs versus 1.79% for sell-offs. Powers (2001) documents that two-day cumulative abnormal returns (CAR) have been found to range between 2.5% and 3.5% in the case of spin-off announcements and 1% and 2% for sell-off announcements. This study solely focuses on the latter of the two, since sell-offs constitute the vast majority of oil and gas divestitures as described in the data section and generally provide the divesting company with cash proceeds. Equity carve-outs, the third form of divestiture where the parent company sells an equity stake in a subsidiary to outside investors, but maintains a majority stake, have also been found to provide positive abnormal returns to the parent company's shareholders, in the range of 1.5% to 2.5% of two-day CARs (Klein et al., 1991). Given that divestitures should only be undertaken when the net present value (NPV) is positive, later studies have consistently found positive returns, albeit to differing degrees (Brauer & Schimmer, 2010). This leads to the first hypothesis:

> *H1: Announcement returns on the divestiture announcement date are positive for sell-offs by oil and gas companies.*

For all three divestiture modes, CARs are found to be positively related to the relative size of the divestiture to the parent company. The section below explores the avenues through which divestitures have been argued to create value.

2.2.2 Sources of value creation

Brauer and Schimmer (2010) derived from strategy and finance research an overview of the five main hypotheses on sources of shareholder value creation through divestitures. These consist of the refocusing, pure play, information asymmetry, financing and managerial incentive hypotheses. The five sections below briefly summarize these potential drivers of returns.

2.1.2.1 Refocusing hypothesis

Research has previously found negative value effects from over-diversification, the so-called diversification discount (Berger and Ofek, 1995). Consequently, the positive market reaction to divestitures has been related to a reversal of this discount. It has been argued that a reduction in managerial and operational inefficiencies, especially regarding financial resource allocation or cross-divisional subsidizing, results from this refocusing (Schipper and Smith, 1983). This theory builds upon empirical research showing that highly diversified firms earn greater divestiture announcement returns. The same has been found for divestitures of business units that belong to different sectors than the parent (John and Ofek, 1995).

2.1.2.2 Pure play hypothesis

The pure play hypothesis, also dubbed the complexity or under-valuation hypothesis, is related to the refocusing hypothesis. Though only true for spin-offs and carve-outs, separating parent and subsidiary into different units helps the market better understand the true value of the security. Zuckermann (2000) has argued that the effort of firms to help financial analysts understand their structure more easily will be rewarded by capital markets. Analysts, who usually are specialized by industry, can experience difficulties in valuing diversified firms. Additionally, capital markets should react positively to the fact that the newly formed entity must provide periodic financial reports. Lastly, Vijh (2002) argues that different types of investors might emerge, to which these pure play securities are more attractive which generates positive announcement returns.

2.1.2.3 Information asymmetry hypothesis

This hypothesis builds upon the pecking order theory of corporate financing by Myers and Majluf (1984) and the empirical observation that spin-offs are associated with higher returns than sell-offs. According to this theory, managers acting in the interest of current shareholders should be reluctant to raise new equity if the cost of issuing shares at the current (bargain) price outweighs the NPV of a new investment. However, rational managers should issue new equity in case they have private information that their shares are overvalued. Following this reasoning, investors will view an issuance as a bad signal and consequently reduce the share price. Selling off shares of a subsidiary in a sell-off or carve-out, rather than own stock, may however signal that management sees the parent's shares as undervalued, which causes a positive market reaction. Furthermore, the higher returns for spin-offs are explained through the absence of a transfer in ownership, unlike with sell-offs and carve-outs. The subsidiary is not effectively 'sold', conveying information that management believes their shares are undervalued and wants to reduce this information asymmetry, but not sell the assets (Krishnaswami and Subramaniam, 1999).

2.1.2.4 Financing hypothesis

According to Lang et al. (1995), asset sales are often advantageous financing mechanisms when a firm is capital constraint and access to external capital is limited. Asset sales relax these financing constraints and allow firms to invest in positive NPV projects that would otherwise not be undertaken, thus increasing the value of the firm. Additionally, if the divested segment would be overinvesting, divesting relaxes constraints on the remaining segments, improving overall investment policy efficiency.

2.1.2.5 Managerial incentive hypothesis

The last hypothesis only applies to spin-offs and carve-outs, where the divested unit functions as a separate entity post divestiture. It argues that managers face more efficient compensation contracts when only being responsible for the subsidiary. Research has shown that managers receiving stock-based compensation after a spin-off create value through better exploiting investment opportunities, as the stock value of the new entity is a much better signal of management's performance compared to that of the diversified firm (Aron, 1991).

2.1.2.6 Program divestitures

The above hypotheses all focus on divestitures as stand-alone events. From a strategic point of view, Brauer and Schimmer (2010) argue for a broader view on value creation by taking a program-based perspective, viewing divestitures as possibly interlinked events. They conclude that divestitures that are part of a divestment program generate higher abnormal returns compared to stand-alone divestments, suggesting that the additional value originates from a clear strategic intent and shared business logic.

This program-based perspective could be extended to oil and gas companies' commitment toward repositioning themselves for the energy transition. Different large oil and gas companies have shown a differing degree of this commitment, with European majors such as Total, Shell and Equinor having set targets to reduce carbon intensity by much more than their U.S. competitors. However, both groups are expected to divest assets worth tens of billions of dollars in the coming years (Guldbrandsøy and Haarmann, 2020). Divestitures following up on a clear strategy as set out by climate targets, might thus be associated with higher announcement returns because of a similar internal consistency. Additionally, higher returns could be expected because of the strategic relevance of these divestitures. Early research on the topic has found that divestitures that "impact the way a firm does business" receive higher abnormal returns as these transactions play a more important role and have a greater impact on future earnings (Montgomery et al., 1984, p.833). Firms with higher climate ambitions arguably impact their operations more through divestitures, although in this case the main motivation is not necessarily to improve future earnings.

2.3 Environment related effects on shareholder value

No research has yet been done relating shareholder value directly to environmental performance through divestitures. However, a fast-increasing body of literature is documenting the effects of corporate environmental performance as part of the ESG relation to shareholder value and stock performance. In contrast to divestitures, acquisitions in the renewable energy space have gained scholarly attention, as well as the broader value effects of voluntary reductions in (greenhouse gas) emissions. Lastly, this section discusses the previously found impact of the exposure of corporate greenwashing on companies' share prices.

2.3.1 ESG effects on shareholder value

Taking a quantitative perspective, Aust (2013) explains that ESG initiatives impact share prices through two avenues. The first driver is financial performance; mainly the income and cash flow that is derived from ESG investments and practices. Secondly, and potentially more importantly, stock prices are directly affected by investor perceptions and behavior, which are included in the (earnings) multiple that the market values the stock with. Fama and French (2007) document how investor preferences factor into companies' cost of capital due to their impact on demand for the companies' stock. As stock prices respond to supply and demand, those companies whose stocks face lower demand (e.g., due to low ESG scores) will exhibit lower prices and therefore a higher cost of capital. Valuation multiples, usually based on earnings per share (EPS) or EBITDA include many characteristics such as growth, leverage, business model and ESG performance, creating difficulty in measuring a direct effect of any one of these drivers. Aust (2013) disentangles these effects by calculating an implicit discount rate based on earnings forecasts. Controlling for factors such as growth, industry, leverage, etc. the author finds that ESG performance-effects range from 30 to 80 basis points in discount rate, depending on the industry. This constitutes a significant effect, as reducing the discount rate by 50 basis points could result in a 10 to 12 percent increase in stock price for industrial firms such as General Electric or Dow Chemical, representing billions of dollars in enterprise value. Aust also states that environmental characteristics are more important than e.g., socially responsible sourcing. Specifically, pollution-related performance is found to be among the most influential factors in calculating ESG-related discount rates, whereas reporting and disclosure issues that do not generate major negative press are found to be of little importance.

Analysis by Deloitte (2022) shows that oil and gas acquirers with high ESG scores have outperformed their sectoral index in 79 percent of the cases, compared to 64 percent and 57 percent for average and low ESG scores, from 2014 until 2021. However, the report states this benefit is mainly due to mitigated environmental risks during down-cycles, when underperformance of high ESG-scoring companies is lower compared to those with weak scores. Up-cycles have provided little extra benefit for high ESG-scoring companies. This is consistent with research proposing that ESG factors impact firm risk, including systematic risk, regulatory risk, reputational risk, litigation risk, and more (Gillan et al., 2021). Reduced risk has been found to cause resilience during times of economic crisis (Lins et al., 2017). Gillan et al. (2021) summarize that a causal effect of ESG (and similarly, CSR or corporate social responsibility) attributes on shareholder value could either be positive or negative, due to the unknown direction of the causality. Companies exhibiting greater ESG efforts might suffer from managerial agency problems, as companies that have sufficient resources have the possibility to spend these resources on ESG aspects. In case this is not enhancing shareholder value, this could consequently mean that managers enhance their own utility at the expense of shareholders (Bénabou and Tirole, 2010). For example, Hong et al. (2012) find that ESG performance increases for financially constrained firms compared to less-constrained firms, along with idiosyncratic stock returns. This means that managers start spending on ESG once they have the opportunity, as the effect is found to be strongest once firms exit the financially constraint sphere. Servaes and Tamayo (2013) find that firms that advertise exhibit a positive relation between ESG activities and shareholder value, whereas firms that do not exhibit either no or a negative relation. Most relevant for this research, Bolton and Kacperczyk (2021) conclude that firms with low CO_2 emissions intensity have a higher firm value because they earn low stock returns, i.e. a lower discount rate that is applied to the future firm value. The authors apply a stock pricing model based on known return predictors such as size and book-to-market ratio, as well as unexpected profitability. Based on these previously proven return-predicting risk factors, they cannot explain lower stock returns for low CO_2 firms through a lower level or risk, and attribute this to a low cost of capital due to exclusionary screening by institutional investors. Therefore, these companies are argued to be valued more highly because they are more likely to pass the screening of institutional investors. Gillan et al. (2021) conclude that more research on the relationship is necessary and that other variables such as the political leaning of key corporate stakeholders or general changes in the political environment should be included.

2.3.2 Green acquisitions

Having a somewhat similar impact to the disposal of dirty assets, the question whether the acquisition of green (energy) assets provides buyers with better financial performance and shareholder value has recently started to gain traction in academic research. Not an insignificant group of buyers itself, major oil and gas companies accounted for 9 percent of global renewable energy acquisitions between 2018 and 2021 (Deloitte, 2022). In one of the first studies on the topic, Mirvis (2006) states that bidders can benefit from targeting sustainable firms if there is a strategic and cultural fit when taking a long-term perspective. Salvi et al. (2018) study 84 transactions in Europe and North America both within and outside the green sector, and analyze bidders' post-acquisition financial performance. They find that the change in ROA both two and three years after the acquisition is significantly higher for buyers of targets in the green sector than other targets. The change in ROA is positive for the first group, whereas ROA has declined for the non-green subsample. The authors state that this difference exists even as bidders are willing to pay higher premia for targets with superior environmental management. Aktas et al. (2011) additionally find significantly positive effects of a target's environmental performance on acquirer gains. Similarly, different studies suggest that the ESG or CSR score of the acquirer is positively related to acquirer announcement returns, while socially responsible firms are also more likely to acquire high CSR-scoring firms (Zhang et al., 2017; Krishnamurti et al., 2020).

2.3.3 Voluntary emissions reduction

Although, as argued before, divestitures following high climate targets potentially benefit from a greater degree of strategic relevance and internal consistency, there is uncertainty about the financial consequences of the reduction of polluting activities in general. Several studies have found a positive association between voluntary emissions reductions and firm performance (e.g., Hart & Ahuja, 1996; King and Lenox, 2001), whereas others have found insignificant or even negative financial effects (Fisher-Vanden and Thorburn, 2011; Jacobs et al., 2010). Jacobs (2014) in an event study finds that positive value effects observed in the 1980s and 1990s have turned slightly negative during the first decade of this century, although the market reaction is more positive for announcements of reductions in greenhouse gas emissions compared to other emission types. Based on these findings, the author stresses the importance of evaluating this relationship in its specific context. Because companies that announced more ambitious emissions targets can be expected to divest more polluting assets seeking to make good on these pledges (Raval, 2021), Jacobs' research suggests these firms currently would experience lower announcement returns. No research has yet been done relating the value effects of divestitures to climate targets (or more directly, emissions reductions) and the above literature suggests contrasting views on the direction of any relationship. Consequently, the following hypothesis is defined:

H2: Companies that have made a stronger commitment to reduce greenhouse gas emissions experience similar divestiture announcement returns to those that have not.

Companies' environmental commitments will be assessed according to the methodology of the Environmental Defense Fund (2022), who have studied oil and gas M&A impact on environmental disclosure and commitments. This includes data on targets and partnerships, as detailed in the methodology section.

2.3.4 Greenwashing

As mentioned, divestitures disposing of polluting assets could be regarded as a form of greenwashing, advertising environmentally friendly practices while not actually creating value for society in terms of limiting global warming. There is limited evidence on the relationship between corporate greenwashing and shareholder value, with the exception of Du (2015), who performs an event study on the exposure of greenwashing by Chinese public firms. He finds that the practice of greenwashing destroys shareholder value when exposed. The author also finds that actual corporate environmental performance is significantly positively associated with abnormal returns for companies found to engage in greenwashing practices. Furthermore, the announcement of adverse, passive or negative environmental incidents triggers a negative market reaction, whereas better environmental performance has caused stock prices to go up (Dasgupta et al., 2001; Walley and Whitehead, 1994). Considering the argument that all oil and gas companies engage in greenwashing to some extent when divesting, those that perform better environmentally could be expected to earn superior returns.

First, to test whether the market differentiates between actual environmental performance at divestiture, the third hypothesis is defined:

> *H3: Companies showing better actual environmental performance earn higher divestiture announcement returns than their peers.*

This hypothesis is tested on a transaction-specific level by distinguishing between the uses of the proceeds of the divestiture mentioned in the press release. For example, the decision between investing the proceeds in renewable energy sources, or to invest in the company's core business, reveals a different level of commitment toward reducing emissions. Secondly, a broader company environmental performance score by the World Benchmarking Alliance is accessed for the subset of companies included in this assessment. In addition to both metrics, an estimate of the divested assets' carbon intensity is included based on their 4-digit SIC code, as provided by BofA Merrill Lynch (2013).

Second, following the definition of greenwashing as stated in the introduction, namely the act of making people believe that a company is doing more to protect the environment than it really is, a greenwashing coefficient is constructed equaling the difference between companies' (standardized) aforementioned environmental commitment score and their actual performance scores. Although Du (2015) documents a negative share price reaction at exposure of greenwashing, it is uncertain whether these divestitures' greenwashing implications are comparable to the explicit manner of exposure in that study.

Subsequently, the fourth hypothesis is defined to test for a relation between this greenwashing coefficient and announcement returns:

H4: The extent to which companies engage in greenwashing (i.e., the differential between stated environmental commitments and actual performance) has no effect on divestiture announcement returns.

2.4 Oil and gas industry characteristics

The oil and gas industry is categorized into three major subsectors: upstream, midstream and downstream. These names refer to the activities' vertical position in the supply chain, from exploring and extracting oil reserves to the delivery of the refined end-product. The upstream sector, also referred to as exploration and production (E&P), contains the exploring, locating and producing of crude oil and natural gas from both onshore and offshore fields. Midstream activities include transportation (through pipelines, oil tankers, rail, barge or truck), storage and wholesale marketing of both crude and refined petroleum products. This sector mainly consists of pipelines, being the most convenient method to transport liquids and gases over long distances. Downstream activities or assets include refinery, petrochemical plants and distribution of petroleum products (Al-Janabi, 2020).

2.4.1 Industry M&A determinants

This thesis focuses only on sell-offs by oil and gas companies, which are thus acquisitions for other companies. Therefore, industry M&A drivers can be expected to influence these divestitures. Research on the rationale for M&A in the oil and gas industry started with Ferguson and Popkin (1982), investigating why excessive takeover premiums are observed in the sector while they explain that the market price of a target should equal the value of its reserves. The authors reason that these premiums come from tax shields due to depreciation of oil reserves, valued more highly on the books of the acquirer than the target after the acquisition. Hsu et al. (2017) study the motivations for upstream oil and gas M&A in the U.S. and find evidence supporting that industry-specific factors are more important than overall economic conditions in determining M&A activities. Specifically, the oil price is highly correlated to deal activity. Oil and gas production is a second influential factor. The authors also find evidence of waves in M&A activity, which interestingly differ in time per shale region. They find these waves to coincide with the development and production time frames in the corresponding region. Ng and Donker (2013) find evidence showing that energy reserves and prices cause and affect both deal activity and value in the Canadian oil and gas industry between 1990 and 2008. The authors find that acquirers are motivated to purchase reserves, which consist of finite resources and therefore will increase in value and maintain companies' right of existence. Targets on the other hand are motivated to time the market for energy prices when selling. This last finding is consistent with the behavioral stock market-driven acquisitions view of Schleifer and Vishny (2003). However, Deloitte (2022) has recently stated that oil and gas M&A activity is starting to decouple from oil prices, based on global data. In contrast to a higher correlation previously, a 75 percent rebound in oil prices in 2021 pared with increased deal activity of a mere 18 percent compared to 2020. The report mentions increased shareholder payouts from divestments, a declining reserves replacement rate and the reducing of companies' environmental footprint as the main reasons for the below par increase in acquisition activity.

2.4.2 Recent M&A trends

In an analysis of global oil and gas transactions in 2021, Deloitte (2022) finds upstream deal value, the subsector traditionally dominating oil and gas M&A activity, to have risen 70 percent from 2020 levels to $138 billion. Although still at a 15-year low excluding 2020, this sharp rise is mainly attributed to oil majors divesting fossil fuel assets. Consequently, upstream transactions are found to be the main category influenced by the energy transition, with conglomerates shedding non-core assets and solidifying niche positions. The report states that upstream activity currently results from capital discipline, an increasing focus on green energy and rising productivity gains, as rig efficiency has significantly increased. A large majority, 85 percent of upstream assets, were sold to pure-play E&Ps. Assets have generally shifted from large to smaller oil and gas companies as consolidation plays out at the basin level. Another reason for the shift towards smaller companies is the high level of scrutiny in recent years from antitrust authorities – globally, and especially in the U.S. – that creates difficulty for large corporations to acquire these assets (Allen & Overy, 2022). Midstream asset transactions are traditionally stable due to their take-or-pay model, where customers have to either take the product or pay a penalty, reducing cyclicality in the market. These assets have recently received substantial interest from infrastructure funds, a form of private equity, who have invested in infrastructure for new low-carbon energies. In the downstream sector, transactions have recently shifted from conventional refinery and distribution assets toward more consumer-oriented assets such as convenience-store service stations and private aviation services. Renewable downstream assets such as renewable diesel refinery units have also increasingly shifted ownership. There is generally a higher amount of downstream transaction activity during times of oil price declines, while there is less activity when the oil price is recovering. This is because falling oil prices shift value from upstream to downstream and vice versa (Deloitte, 2022).

Only 10 percent of total oil and gas transactions in 2021 named ESG as the key rationale or communicated ESG considerations to stakeholders. One reason the report mentions is that upstream M&A activity is currently being driven by more small-sized and private E&Ps who prioritize financial metrics. Another reason lies in the absence of uniform ESG metrics and benchmarks, according to a survey of energy and manufacturing executives. Due to the degree of fragmentation in the renewables industry, oil and gas companies are increasingly making use of joint ventures, as BP CEO Bernard Looney stated this is a more probable route to reaching their renewable energy targets compared to M&A (Deloitte, 2022). Harrigan (1988) states that the consolidation of fragmented industries through joint ventures could replace price competition with other behavior that increases attractiveness for all investing firms, and simultaneously benefit customers through technical efficiencies.

2.5 Arbitrage due to organizational form

2.5.1 Public versus private

Lastly, it is of interest to consider who buys which assets, and whether buyer characteristics have an impact on the announcement returns. As mentioned, a large shift from public to private ownership has been observed recently, expectedly due to the lower or inexistent environmental pressure from shareholders of private companies. Private equity firms have been reported to be among the top buyers of oil and gas assets, having completed around five hundred oil, gas and coal transactions for a combined $60 billion in 2020 and 2021 (The Economist, 2022). Data from the Environmental Defense Fund (EDF) shows that over the last five years, oil and gas asset transfers from public-to-private companies exceeded the number of private-to-public transactions by 64% (EDF, 2022). Although more broadly than through divestitures, a similar wave in companies' decisions to go from being publicly listed to a private entity has been observed after the passage of the Sarbanes-Oxley Act of 2002 (Engel et al., 2007). This act came in response to several financial scandals and imposed corporate governance related regulations on publicly traded firms. The authors additionally concluded that abnormal returns surrounding the going-private announcement are related to their proxies for the costs and benefits of Sarbanes-Oxley for the firm. Similarly, as the shareholder pressure from public companies' shareholders imposes a cost on firms owning polluting assets, a private buyer can create value through buying the assets, especially those with the highest benefits of going private. Teschner and Paul (2021) reason that sellers can participate in their buyers' value creation potential through premiums on the transaction price. This value creation potential can arise from having a superior organizational form, or a comparative advantage in running the asset. Assuming that managers exploit this potential, public oil and gas companies are expected to divest their most polluting assets to private businesses as the differential in organizational form is most important here. This defines the fifth hypothesis:

> *H5: More polluting oil and gas assets are more often divested to private companies compared to other oil and gas assets.*

This hypothesis will be tested based on the SIC code of the divested asset. BofA Merrill Lynch (2013) has constructed an average carbon intensity level, measured in kg CO_2 emitted per USD revenue for each 4-digit SIC code. This dataset is based on reporting by global listed companies in 2011 and makes use of an Inverse Distance Weighted Interpolation, in order to match the emissions with the exact activity.

2.5.2 Differing environmental commitments

Apart from the large presence of public-to-private divestitures, over 30% of the transferred assets have moved to owners with lower environmental commitments in 2021, according to the EDF. This figure has increased sharply both in terms of the number of transactions and transaction value since 2018 (EDF, 2022). Deloitte (2022) has found that the average ESG score of buyers in oil and gas acquisitions has slightly decreased between 2014 and 2020, with the largest companies scoring higher on average compared to smaller buyers. As an example, after Shell, Eni and Total sold off their drilling rights in the Nigerian Umuechem oilfield to private equity-backed Trans-Niger Oil & Gas, flaring emissions from the wells increased nearly ninefold (EDF, 2022). As reasoned above, these “reduced-environmental-commitment” deals – together with the public-to-private transactions labelled “stewardship-at-risk” transactions by the EDF – provide potential arbitrage opportunities through the lowered environment-related costs for the new owner. Clubb and Stouraitis (2002) state that the profitability to the seller, measured as the difference in transaction price and value-in-use for the seller, impacts ARs very strongly. This difference results mainly from a better fit between the divested asset and its new owner, in this case potentially due to shareholder pressure (Teschner and Paul, 2021). Therefore, it is of interest to test whether these arbitrage opportunities related to environmental commitments provide divesting companies with higher abnormal returns:

> *H6: “Stewardship-at-risk” divestitures earn greater announcement returns compared to other divestitures in the sample.*

To classify transactions as reducing in environmental commitments, again the approach of EDF (2022) is followed, as specified in the methodology section.

2.6 Conclusion

Current divestiture literature is limited mainly to the determinants and shareholder value implications, as well as the sources of value creation. Although environmental effects have not directly been studied in connection to divestitures, there is a large and growing body of literature documenting the sustainability (and more broadly ESG) relation with shareholder value, also through acquisitions and voluntary reductions in emissions. Generally, a positive relation between sustainability and shareholder value is found. However, considering the possibility that the market directly links polluting divestitures to greenwashing for which the firm will ultimately be punished, a less positive scenario might be expected in terms of announcement returns. Lastly, considering that divesting companies can benefit from a reduction in the costs associated with environmental pressure from shareholders, companies divesting to those parties exhibiting lower pressure could be expected to earn higher announcement returns.

CHAPTER 3 Data

3.1 *Sample selection*

The studied sample period ranges from the beginning of 2017 until the end of 2021. These years are taken as the Paris Agreement on limiting global warming came into effect in November 2016, which can be seen as an important starting moment for the shift in oil and gas companies' asset portfolios. The sample ends at the end of 2021 to avoid any influence from divestments of Russian assets following western sanctions in 2022, which have caused large losses for several oil and gas companies, while at the same time record profits were made on other businesses (Maurer, 2022).

Table 1

Sample selection. This table presents the sample selection and events leading to exclusion, starting with the full population of global divestitures by oil and gas companies in between 2017 and 2021 as provided by ThomsonOne.

Divestitures	Dropped	Number of events
Deal value ≥ $150m		358
Private parent	-82	276
Spin-offs	-2	274
Carve-outs	-3	271
Parent is bankrupt	-15	256
Sales to subsidiaries	-15	241
Confounding events	-63	178
Simultaneous divestitures	-5	173
Extremely illiquid stock	-1	172
Total sample of events	-187	172

Data on 172 divestiture announcements by 71 global, publicly listed oil and gas companies is obtained from ThomsonOne. This includes data on the SIC codes of the target, the acquirer and their ultimate parent. The transactions are filtered to include those marked as divestments by ThomsonOne, where the divesting company is in the 'Oil and Gas; Petroleum Refining' industry, consisting of 2-digit SIC codes 13, 29 and 46. Only transactions with a value of $150 million and over are included in order to only study the most significant events. According to Thomson Reuters (2023), this database offers "a complete picture of the deal-making landscape". Any potential omissions are considered to occur at random, as no information on a potential selection bias can be found. Two spin-offs and three carve-outs that were originally in the sample are excluded as these do not represent a change in ownership of the asset, meaning that only asset sales are included. Fifteen instances where divesting companies were bankrupt at the time of divestiture, either in Chapter 11 or due to having a negative book equity value, are filtered out as these divestitures might very well be involuntary and therefore not representative for this study. Furthermore, fifteen sales to majority-owned subsidiaries are excluded. There were 63 instances of significant other events taking place within three trading days before and until one day after the announcement, which have been deleted from the sample. An overview of the confounding events can be found in Table 19 in Appendix A. In five cases, two divestitures by the same parent were announced on the same day or within one day of each other. In these cases, the values are combined and they are treated as a single divestiture since it is impossible to observe the effects separately. Lastly, one security is dropped due to having extremely illiquid shares. Figure 1 shows the distribution of the studied divestitures and their aggregate value over the sample period.

Figure 1

Distribution of announced oil and gas divestitures by volume and transaction value. This figure only includes the events in the studied sample, whereas the number of events treats simultaneous divestitures as one, totalling 172.

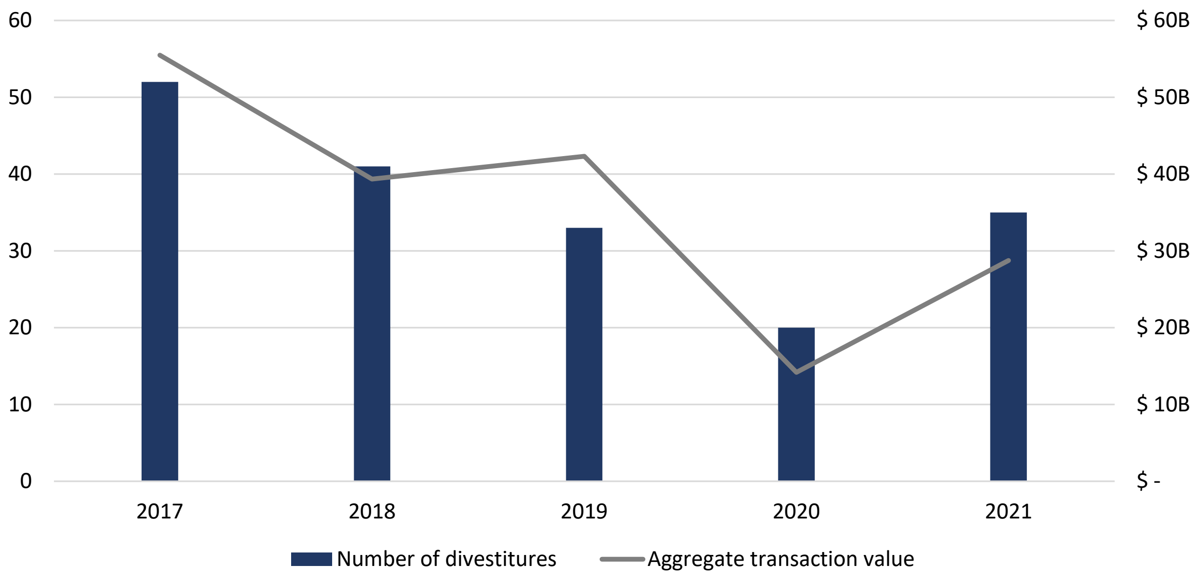


Table 2 provides an overview of the SIC classifications of the divested target, its divesting parent, the acquiring company and parent of the acquiring company. In the cases where two simultaneous divestitures were announced, the SIC code of the largest divestiture is reported. It is interesting to note that mainly oil and gas exploration and production assets (SIC code 13) are being divested. As mentioned, these assets are with distance the most polluting, but also represent the core of oil and gas companies' business and therefore are strategic in nature. On the acquirer side, holdings and investment offices are largely represented with circa 27 percent of acquiring parent companies. This category consists of the subcategories Holding Offices (i.e., bank holding companies and those not classified in other industries), Investment Offices, Trusts and Miscellaneous Investing companies. An overview of the divesting parent companies and their number of announced divestitures is reported in Table 20 in Appendix A. Table 3 provides the descriptive statistics, and a pairwise correlation matrix of the dependent and independent variables used is reported in Table 21 in Appendix A.

Table 2

SIC classifications of involved entities. This table presents the number of announced divestitures with 2-digit SIC classifications of the involved entities and acquirer ownership type in the studied sample.

2-digit SIC classification	Target	Parent	Acquirer	Parent
12: Bituminous Coal and Lignite Mining	-	-	-	1
13: Oil and Gas Extraction	120	121	83	70
16: Heavy Construction except Building	-	-	-	1
17: Construction Special Trade Contractors	-	-	1	1
20: Food and Kindred Products	-	-	-	1
23: Apparel and Other Textile Products	-	-	-	1
28: Chemical & Allied Products	3	-	6	6
29: Petroleum & Coal Products	11	38	7	12
38: Instruments and Related Products	-	-	1	1
42: Trucking & Warehousing	2	-	-	-
44: Water Transportation	-	-	1	1
46: Pipelines, Except Natural Gas	5	13	7	5
49: Electric, Gas, & Sanitary Services	13	-	12	8
50: Wholesale Trade – Durable Goods	-	-	-	1
51: Wholesale Trade – Nondurable Goods	8	-	7	5
53: General Merchandise Stores	-	-	1	1
54: Food Stores	-	-	1	1
55: Automotive Dealers & Service Stations	4	-	3	2
59: Miscellaneous Retail	2	-	-	-
60: Depository Institutions	-	-	-	2
62: Security & Commodity Brokers	-	-	-	1
63: Insurance Carriers	-	-	1	3
64: Insurance Agents, Brokers and Service	-	-	1	-
65: Real Estate	3	-	1	1
67: Holding & Other Investment Offices	1	-	38[1]	46[1]
73: Business Services	-	-	1	1
Publicly owned	n/a	172	n/a	77
Privately owned	n/a	-	n/a	95
Total	172	172	172	172

[1]Includes 5 investor groups of companies in other sectors as per ThomsonOne definition.

Table 3

Descriptive statistics. This table presents the sample consisting of 172 oil and gas divestiture announcements of ≥ $150m between 2017 and 2021, including all dependent, independent and control variables used. The ThomsonOne data on acquirers and targets is matched with data from CRSP, Compustat, WBA, Yahoo Finance, Investing.com and corporate financial statements/press releases. Asset subindustries are based on targets' SIC code and greenwashing scores are computed as the difference between a parent's (normalized) environmental commitment score and the divestiture's (normalized) performance score based on both the use of proceeds and the WBA score. Acronyms are provided for all (dummy) variables included in the model specifications in section 4.6.

Variable	Acronym	N	Mean	Median	SD	Min	Max
Divestiture Characteristics							
CAR (%) (-1, +1)	CAR	172	1.080	0.013	7.016	-14.420	53.946
Deal value ($bn)	dealvalue	172	0.995	0.510	1.679	0.150	13.240
Carbon intensity (kg / $ rev.)	emissions	172	0.686	0.814	0.646	0.005	3.961
Small (< 10%)		172	0.698	1.000	0.461	0.000	1.000
Medium (10% – 50%)	medium	172	0.244	0.000	0.431	0.000	1.000
Large (≥ 50%)	large	172	0.058	0.000	0.235	0.000	1.000
Subindustry: upstream		172	0.686	1.000	0.465	0.000	1.000
Subindustry: midstream		172	0.081	0.000	0.274	0.000	1.000
Subindustry: downstream		172	0.145	0.000	0.353	0.000	1.000
Subindustry: other		172	0.087	0.000	0.283	0.000	1.000
Proceeds category: green	prc_green	154	0.091	0.000	0.288	0.000	1.000
Proceeds category: neutral	prc_neutral	154	0.494	0.000	0.502	0.000	1.000
Proceeds category: brown	prc_brown	154	0.416	0.000	0.494	0.000	1.000
Greenwashing score proceeds	grw_prc	154	0.422	0.375	0.217	0.000	1.000
Target Parent Characteristics							
Market capitalization ($bn)	mktcapb	172	56.286	18.926	76.938	0.127	369.899
ROA	ROA	172	-0.012	0.010	0.071	-0.267	0.157
Debt-to-equity	DE	172	1.565	0.627	6.079	0.019	56.502
Region: Western		172	0.843	1.000	0.365	0.000	1.000
Region: Arabic		172	0.023	0.000	0.151	0.000	1.000
Region: Emerging		172	0.134	0.000	0.341	0.000	1.000
Environmental commitment score	env_com	172	0.686	0.000	1.142	0.000	4.000
WBA performance score[1]	perf_WBA	147	3.290	3.300	1.370	1.000	8.100
Greenwashing score WBA[1]	grw_WBA	147	0.568	0.553	0.144	0.390	0.915
Acquirer Characteristics							
Private acquirer	private_acq	172	0.552	1.000	0.499	0.000	1.000
Stewardship-at-risk transaction	SaR	172	0.686	1.000	0.465	0.000	1.000

[1]Using the extended sample including divestitures ≥ $10m rather than 150m due to WBA coverage limitations.

The average three-day CAR is 1.08 percent, in line with previous literature reporting positive value creation, although at the lower end of the range found by Powers (2001) of 1 to 2 percent over a two-day event window. Interestingly, the median CAR is with 0.01 percent very close to zero, meaning that almost as many negative as positive CARs have occurred. Furthermore, only 5.8 percent of the transactions fell in to the 'large' category, in which the deal value constituted 50 percent or more of the divesting parent's market capitalization. Contrastingly, the 'small' divestitures of less than 10 percent of market capitalization constitute the largest group with 69.8 percent of the events. The uses of the proceeds (as categorized in Table 4 below) are only found to be 'green' in 9.1 percent of the cases, meaning that only a small amount of divestitures' press releases mentioned any renewable investment at all. However, 'neutral' uses including debt reduction and dividend payments have been slightly more prevalent as compared to 'brown' ones (i.e., investing in core oil and gas projects). Interestingly, parent company ROA averaged -1.2% in the studied sample over the three years prior to the divestiture, which is inconsistent with previous divestiture studies logically reporting positive ROAs (Teschner and Paul, 2021). An explanation for this would be the relatively low oil price climate during much of the previous decade and 2020. Furthermore, divesting companies have mainly been western, representing 84.3 percent versus only 2.3 percent by Arabic and 13.4 percent by emerging country (as classified by MSCI) firms. This is potentially due in part to this study's limitation on the parent to be publicly traded, in combination with more developed financial markets in the western world. The average number of divesting companies' environmental commitments, reported as the 'environmental commitment score', is below 1 such that most firms have not made any of the four commitments described in section 4.2. Lastly, 68.6 percent of divestitures constituted a 'stewardship-at-risk' divestiture, largely due to the 55 percent moving to a private owner. The correlation matrix regarding the main sample in Table 21 in Appendix A shows that only the relative size dummies 'small' and 'large', and thus none of the environmental variables are significantly correlated to CARs.

3.1.1 Adjusted samples

Tables 1, 2 and 3 present the data regarding the main sample that is used throughout this thesis. However, in two instances a different sample is studied. First, as explained in detail below, hypothesis 3 regarding the actual environmental performance score, and consequently hypothesis 4 on the greenwashing score which is constructed from it, are tested using performance scores as assessed by the World Benchmarking Alliance (WBA). Because the WBA only includes data on 100 oil and gas companies, not covering the full original sample, the divestiture size threshold is lowered from $150 million to $10 million. This raises the number of observations from 99 to 147, after the exclusion of six confounding events and three extra cases where two simultaneous transactions are treated as a single divestiture. Because of the limited amount of divestitures by the assessed companies, the implicit assumption is made that the order of companies' scoring in the benchmark, which is based on data from 2019 and 2020, is representative for the whole sample period ranging from 2017 to 2021. Excluding these early two years would result in a sample of 84 divestitures, which is commonly argued to be too small to perform a (panel) regression with multiple control variables (Van Voorhis and Morgan, 2007).

Second, hypothesis 5 on whether more polluting assets move to private companies more often does not require divestitures with confounding events and simultaneous divestitures to be dropped. Therefore, a more complete sample is constructed to test this hypothesis, where these observations have been added back. Descriptive statistics for the two adjusted samples are reported in Tables 22 and 23 and the SIC classifications regarding the sample used for hypothesis 5 are reported in Table 24 in Appendix A.

3.2 Stock market data

Daily data on stock and index prices is obtained from CRSP for parent companies with their primary listing on a U.S. stock exchange. For the companies listed on non-U.S. exchanges, daily historical prices are downloaded from Yahoo Finance or Investing.com. Subsequently, dividend payment dates are checked manually for overlap with the event window, and the dividends are added back to the share price in six instances where it occurred. Data on historical index prices is similarly downloaded from Yahoo Finance and Investing.com. An overview of the benchmark indices used is reported in Table 25 in Appendix A.

3.3 Divestiture and company data

Corporate press releases of the divestitures have been accessed for additional data on the divestitures' characteristics, including the uses of the proceeds. For 112 transactions, the data is taken directly from the press release issued by the divesting firm. For 42 divestitures, announcements from sources including Reuters, SeekingAlpha, S&P Intelligence and energy news sites such as Worldoil.com have been accessed, either because the press release did not contain the relevant information or was not available. In 18 cases, no announcement was found. With regard to the actual environmental impact of the divestitures, up to three mentioned uses of the proceeds have been included in the data. These have subsequently been categorized into one of three categories: 'Brown', 'Neutral' or 'Green'. In 8 cases where no uses of the proceeds were mentioned, the label 'Neutral' is applied, as the company did not give investors reason to believe otherwise at the announcement. The divestitures where no announcement was found have been left out for this analysis. Table 4 presents a categorized overview of the mentioned uses and their prevalence. The divestitures' combined proceeds category is subsequently defined as 'Green' if at least one of the uses falls in the green category, 'Brown' if at least one falls in the brown category and 'Neutral' otherwise.

Press releases are also searched for data on sustainability matters as well as confounding events around the announcement date. Sustainability reports are accessed for additional data on corporate net zero commitments, methane targets and Zero Routine Flaring (ZRF) commitments. Further information on ZRF commitments is taken from the World Bank Zero Routine Flaring by 2030 initiative, and information on Oil and Gas Methane Partnership membership is accessed from the OGMP 2.0 partners list. These variables take value 1 if the company has made the respective commitment at latest the year preceding the divestiture, and zero otherwise. The 'Environmental commitment score' reported in Table 3 presents the sum of these four variables at the time of divestiture.

Table 4

Overview of mentioned uses of the divestiture proceeds. This table provides an overview of all uses mentioned in the corporate press release or divestiture announcement. For 18 divestitures no press release was available. For the other 154 divestitures, up to three uses have been included, consisting of the first three mentioned in the press release.

Use of proceeds	Times mentioned	Totals	Events
Brown			
Investing in core assets	57		
Funding acquisition(s)	8		
Funding future growth	2		
Unknown, divested asset was renewable itself	2		
		69	64
Neutral			
Debt reduction	73		
Distributing to shareholders	23		
Strengthening of balance sheet	20		
General corporate purposes	10		
Not mentioned	8		
Streamlining of business model	2		
		136	76
Green			
Investing in sustainable projects	11		
Transition into renewables	2		
Seeking innovative opportunities	1		
		14	14
Omitted			
No press release available	18		
		18	18
Totals		237	172

Furthermore, the CRSP share data includes the number of shares outstanding for U.S. parent companies, which is otherwise taken from the latest company filing before the divestiture in order to calculate the market capitalization. This figure is needed for the relative size dummy variables of the divestiture to its parent's market capitalization. Further company financial data for the control variables 'ROA' and 'Debt-to-equity' is taken from Compustat (Global) where available, and otherwise from company annual filings. Data on public listings of the acquiring and divesting companies' parents is included in ThomsonOne. An acquirer is consequently defined as private when it does not have a public listing. Additionally, 14 publicly listed financial companies have been reclassified as private, constituting all companies with a primary SIC code starting with '6'. This includes private equity companies such as The Carlyle Group and KKR & Co which would otherwise be classified as public.

Lastly, data on the pollution level of the assets is obtained from BofA Merrill Lynch (2013), who have constructed a carbon sales intensity level for each 4-digit SIC code. This data is constructed based on average number of grams of CO_2 per U.S. dollar of revenue as reported in 2011 by listed companies globally. To calculate the SIC averages based on non-pure players that are active in different industries, the report makes use of an Inverse Distance Weighted Interpolation, in order to match the emissions with the exact activity. Oil and gas companies were among the top reporters of emissions intensity with 91 percent of market capitalization covered, creating some of the most reliable estimates for these SIC codes. The report shows that the methodology forms a reliable estimate of CO_2 footprints based on a low standard error of the gap between measurement with real data and the SIC-based estimates. It reports both direct (Scope 1) and indirect (Scope 2) emission intensities, which are added for the variable 'Carbon intensity'. An overview of the carbon intensity levels is reported in Table 26

3.3 World Benchmarking Alliance climate data

As a second measure of environmental performance, climate scores from the 2021 Climate and Energy Benchmark of the oil and gas sectors by the World Benchmarking Alliance (WBA) are used. The dataset is downloaded from their website, and includes data on 100 of the most influential upstream, midstream and downstream oil and gas companies, regarding their alignment with the Paris Agreement goal to limit global warming to 1.5 degrees (World Benchmarking Alliance, 2021). The EDF (2022) mentions that company reporting on emissions is still largely non-standardized with different companies reporting different metrics, which are also prone to manipulation by management. This creates difficulty in using reported emissions as a proxy for environmental performance, especially with regard to potential greenwashing. The WBA dataset is unique in providing a (more) reliable estimate of not only emissions, but companies' total climate progression. This goes further than mere targets and company reporting, and includes a performance score of nine modules on which the included companies are assessed. These modules are: emission targets, both capital expenditure and R&D investments, the (projected) trend in emissions intensity, management's climate expertise, supplier and client engagement on climate issues, policy engagement and lastly, their development toward a low-carbon business model. The WBA mentions that this is the first comprehensive assessment of oil and gas companies relating to the International Energy Agency's Net Zero Emissions by 2050 Scenario. As mentioned, an extended sample is included lowering the deal size threshold to $10 million.

The performance score consisting of the nine modules mentioned above is presented on a scale of 0 to 20. This score is combined with a narrative score and a trend score to form a total company score. The narrative score assesses companies' alignment with the goals of the Paris Agreement and considers the above performance assessment, as well as their commitment, transition planning, legacy (reputation) and consistency and credibility. This component contributes between 0 and 20 to the total score. Lastly, a trend score between 0 and 2 is included based on whether the WBA deems change likely in a near-term reassessment. Consequently, the overall score represents the sum of the individual scores divided by 42. Table 5 shows the awarded scores for both the complete WBA study and the divesting parent companies. It is interesting to note that higher scoring companies across all measures are overrepresented in the divesting sample. This could also be due to the focus of this study on publicly listed firms. Since the actual environmental performance is of interest, this study only uses the provided performance score and ignores the narrative and trend scores which might respond positively to greenwashing. The 75th percentile is used to separate well-performing firms from others and is used as robustness test.

Table 5

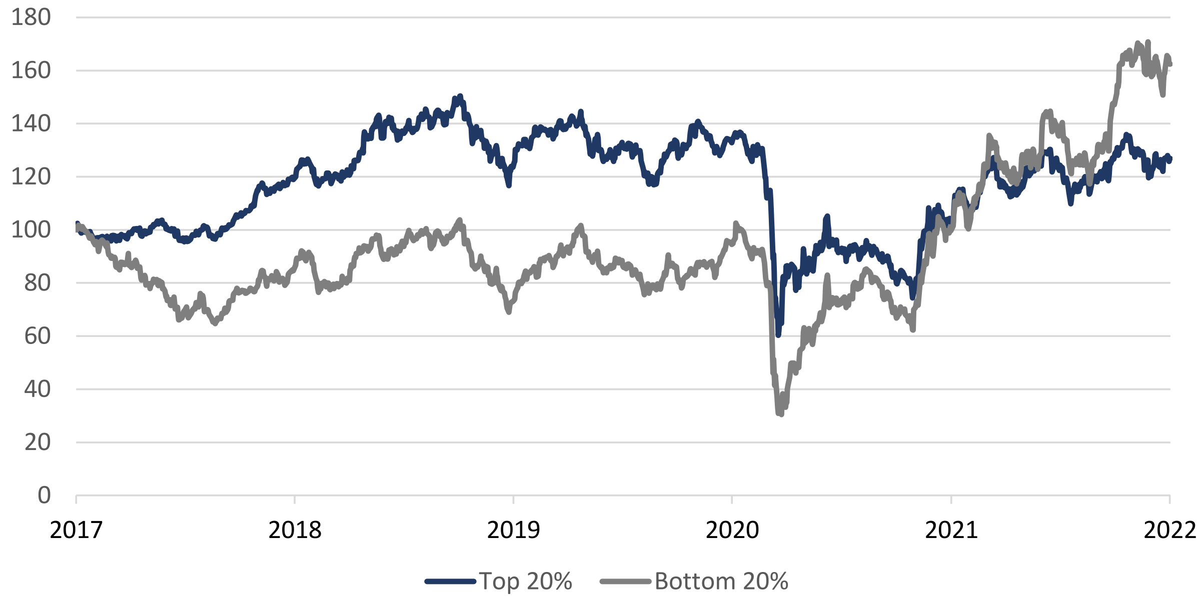
WBA scores for the complete benchmark and studied sample. Due to the restriction on the number of companies included in the assessment, divestitures are included with a transaction value of $10 million or higher, rather than the $150 million in the other analyses. The numbers between parentheses specify the range of possible scores.

Reported score	Mean	Median	St. dev	Min	75th	Max
Sample included in the benchmark (N = 100)						
Performance score (0-20)	2.18	1.75	1.77	0.00	2.83	8.30
Narrative score (0-20)	2.35	0.00	3.72	0.00	5.00	15.00
Trend score (0-2)	0.18	0.00	0.46	0.00	0.00	2.00
Total score (0-100)	11.22	5.20	13.09	0.00	16.95	57.40
Sample included in this study (N = 147)						
Performance score (0-20)	3.29	3.30	1.37	1.00	3.50	8.10
Narrative score (0-20)	3.33	0.00	4.55	0.00	10.00	15.00
Trend score (0-2)	0.36	0.00	0.58	0.00	1.00	2.00
Total score (0-100)	16.64	7.90	14.40	3.60	32.40	57.40

Figure 2 depicts equal weighted index returns of the top and bottom 20 percent of companies in terms of WBA performance score, showing outperformance of the higher scoring firms until 2020, followed by stronger outperformance of the low scoring group post-pandemic. This is in line with low scoring companies focusing more on core oil and gas operations, of which profitability has increased strongly due to soaring commodity prices over the period. The top quintile includes Neste, TotalEnergies, BP, Equinor, Repsol and Marathon Petroleum. The bottom group consists of APA Corp, Pioneer Natural Resources, Santos, Cenovus and Reliance Industries, in descending order of performance.

Figure 2

Equal weighted index returns of the top versus bottom quintile by WBA performance score. The percentiles and included companies are based only on 29 companies included in this study's sample and do not represent the full WBA dataset.



In terms of innovation, several of the firms in the top quintile reported a sizeable proportion of total R&D spending towards low-carbon technologies and technologies to mitigate climate change. In 2019, these figures amounted to 50 percent for Neste, 27 percent for Repsol, 23 percent for TotalEnergies and 20 percent for Equinor. This figure rose to 67 percent for Neste and to 32 percent for Equinor in 2020, whereas Repsol targeted 40 percent by 2022, at the time of the WBA report in 2021. Marathon Petroleum is the only company in the top quintile not reporting this breakdown. Contrastingly, most assessed companies with a lower performance score have not reported their degree of innovation using this metric (WBA, 2021). It is interesting to note that all these top scoring companies that do report this are situated in the European Union, currently facing the highest carbon pricing of 90 USD per ton versus a global average of 6 USD (Black et al., 2022). This is in line with Van den Bergh and Savin (2021) refuting earlier findings in favor of a (albeit small) positive effect of carbon pricing on low-carbon innovation.

CHAPTER 4 Methodology

4.1 Event study methodology

To answer the first hypothesis, the event study methodology following MacKinlay (1997) is used, which is a widely accepted methodology to measure the effect of an economic or firm specific event on the share price of a firm. According to Binder (1998) it has become the standard method of measuring security price reaction to an announcement or event. The impact of the divestiture is modeled by calculating (cumulative) abnormal stock returns around the event date. This methodology assumes the semi-strong form of the efficient market hypothesis, meaning that prices reflect all available public information and directly adapt to include new information. The release of this new information therefore potentially creates a market reaction that is abnormal, i.e. different from the expected return before the information was released. Abnormal returns consequently measure the value creation caused by the announcement, and are defined as follows:

$$AR_{i,t} = RR_{i,t} - ER_{i,t} \quad (1)$$

Here, $AR_{i,t}$ is the abnormal return for stock *i* at time *t*, $RR_{i,t}$ is the realized return and $ER_{i,t}$ is the expected return as measured using the benchmark for stock *i* at time *t*. In line with Brauer and Schimmer (2010), who also study an international sample trading on different stock exchanges, the respective home market index is used as the benchmark to overcome differences in operating hours and non-trading days as well as currency effects. Benchmarks are selected as the respective country or region's oil and gas or energy index if available. In the cases of BP, Lundin Energy, Shell and Total, a domestic oil and gas index was available, but replaced with the country's main index due to extreme correlation with the divesting company. For example, the Euronext AEX Oil and Gas index consists of merely 3 constituents, among which Shell, leading to a beta of 1 and an R^2 of 0.999 with Shell's share price.

The event window is chosen to span the three trading days surrounding the announcement to account for possible information leakage on the day prior to the announcement as well as the possibility that the announcement was released after trading hours. The only exception to this is made for Hess Corporation, which announced two divestitures within one day from another. Here, the event window is modified to span four trading days. Under the assumption that the market immediately incorporates the information from the announcement, adding this additional day should not cause any methodological issues as the expected value of this additional abnormal return is zero, absent from the announcement effect of the combined divestitures. Dann et al. (1977), for example have found that security prices fully adjust to the release of firm-specific information within as little as 15 minutes. Furthermore, the event window has been advised to be as short as possible to minimize the number of confounding events and preserve the power of the test statistic (McWilliams & Siegel, 1997). Divestitures within three trading days of another strategic move by the firm are eliminated from the sample in line with Brauer and Schimmer (2010). The estimation window is set to the 120-day period prior to the event window. This is done using the market model or Capital Asset Pricing Model (CAPM), which is the widely accepted standard in divestiture literature and therefore ensures comparability of results with previous studies (Teschner and Paul, 2021). For each divestiture, a company beta is estimated over the estimation window by fitting the realized returns to the corresponding benchmark returns $R_{m,t}$ using OLS regression:

$$RR_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \tag{2}$$

The expected return for stock *i* at time *t* is subsequently computed by multiplying the estimated β_i with $R_{m,t}$ during the event window. This is then subtracted from the realized return using equation (1) to retrieve the AR. Subsequently, cumulative abnormal returns (CAR) over the event window T for each divestiture are defined as:

$$CAR_{i,\mathrm{T}} = \sum_{t=1}^{T} AR_{i,t} \tag{3}$$

The CARs are then averaged over the sample to test hypothesis 1:

> *H1: Announcement returns on the divestiture announcement date are positive for sell-offs by oil and gas companies.*

The cumulative average abnormal return over the event window *T*, $CAAR_{\mathrm{T}}$, is calculated as follows:

$$CAAR_{\mathrm{T}} = \frac{1}{N}\sum_{i=1}^{N} CAR_{i,T} \tag{4}$$

The statistical significance of $CAAR_{\mathrm{T}}$ will be tested through a t-test on the intercept α of the regression equation:

$$CAR_i = \alpha + \varepsilon_i \tag{5}$$

Sections 4.2 – 4.4 discuss the methodology behind the measurement of corporate environmental commitments, environmental performance and the construction of greenwashing scores. Section 4.5 provides an overview of the control variables used and section 4.6 discusses subsequent model specifications followed by robustness tests in 4.7.

4.2 Environmental commitments measurement

Company environmental commitments are classified following the approach the EDF (2022) has used in determining ‘Reduced-environmental-commitment’ transactions. The institution has defined four important forms of commitments made by companies in the oil and gas sector, which are described below together with their reason for inclusion:

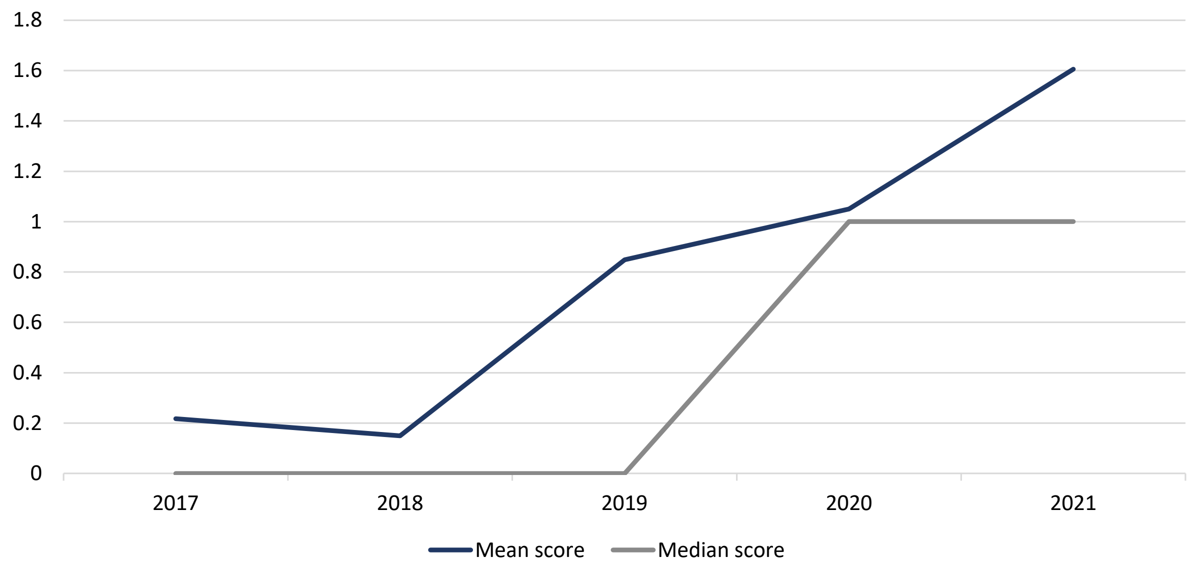
1. The company has made a net zero pledge:
   Having a net zero commitment provides a long-term strategic incentive and mandate to decrease emissions, whereas companies lacking this commitment may have a lower focus on decarbonization.
2. The company has a methane target:
   Methane is a highly potent gas with over 80 times the warming power of CO_2, and is mainly emitted by companies in the oil and gas industry. Companies having an explicit methane target show greater commitment towards limiting these emissions.

3. The company has made a zero routine flaring commitment:
   Gas flaring is the spoilage of gas during production processes into the atmosphere, generating significant CO_2 and methane emissions.
4. The company is a member of the Oil and Gas Methane Partnership 2.0 (OGMP):
   According to the EDF, methane measurement and reporting using generic emission factor-based calculations remains poor and have been shown to understate emissions by 70% or more. The OGMP provides a standardized, transparent science-based framework for measurement and reporting, meaning membership shows additional commitment to methane emissions mitigation.

For each divestiture, the divesting company's 'Environmental commitment score' is set equal to the amount of the above commitments it has announced at the latest the year preceding the transaction. This score thus ranges from 0-4 and provides an equal weight to each of the above commitments. Figure 3 shows rising mean and median scores over the sample of divestitures. Subsequently, a transaction is labeled as a 'Reduced-environmental-commitment' transaction in line with the EDF (2022) when the divestiture involving a seller with any of the above commitments, and an acquirer lacking the same commitment. This means that an acquirer could have a higher total score, but the divestiture would still be classified as a reduction in commitments if it lacks at least one of the seller's commitments at that time. These transactions are then combined with public-to-private transactions to define 'Stewardship-at-risk' transactions, as in the latter case reporting levels will most likely be lower as well.

Figure 3

Mean and median environmental commitment scores across years. This figure depicts the mean and median number of environmental commitments made by the 172 companies across the years in the studied sample. The commitments of the year preceding the divestitures are observed and therefore lag actual values by one year.



4.3 Environmental performance measurement

As mentioned, corporate environmental performance is assessed on both a transaction-specific and company-specific level. Environmental performance at the transaction level is observed through the uses of the proceeds that are stated in the divestiture press release or announcement. Although in many cases still a form of intentions, these provide more detailed information about the divesting companies' motivation for the divestiture and their intended actions toward decarbonization compared to general company commitments. Furthermore, this is one of the primary pieces of information available to the market regarding the environmental impact of the divestiture (on the company), whilst also released simultaneously to the divestiture announcement. As described in the data section, the different mentioned uses have been categorized into the labels green, neutral and brown.

As detailed in the data section, company-level environmental performance is assessed using the WBA Oil and Gas Benchmark climate scores. This analysis includes only the company performance sub-score as a binary independent variable. Because a different sample including smaller divestitures is analyzed, some caution regarding the comparability of the results to the other hypotheses is warranted.

Thirdly, the emissions intensity of the target, provided by the 4-digit SIC level averages observed by BofA Merrill Lynch (2013) is included with both performance metrics. This provides an additional measure of environmental performance at the company level, since a divestiture of a highly emitting asset reduces the divesting company's emissions. This variable is not included in the greenwashing coefficient laid out below, because a polluting divestiture improves performance at the company level, but can constitute greenwashing as argued before.

4.4 Greenwashing scores

Lastly, I construct two separate greenwashing scores based on the difference between companies' stated environmental commitments (i.e., the 'Environmental commitment score'), and their actual performance, again measured both through the uses of the divestiture proceeds and the WBA performance score. The coefficients are constructed through first linearly adjusting the environmental commitment and performance scores so that the values are expressed as a fraction of the maximum possible score (e.g., the 'Environmental commitment score' which takes on values 0 through 4 is simply divided by 4 and the 'WBA performance score' by 20). Subsequently, the normalized performance scores for both measures are (separately) subtracted from the normalized commitment score for each divestiture. As these variables now range from [-1, 1] in possible values, these scores are readjusted by adding 1 and dividing the coefficient by 2, to arrive at a percentage greenwashing score. A score of 1 means that a company has stated every possible commitment among the four laid out above, while achieving a zero score on performance, either through having a 'Brown' classification from the use of the proceeds, or from the WBA performance score and therefore scores high in greenwashing. A score of 0 represents the opposite situation, where the company has not publicly stated any of these commitments, but receives a maximum performance score. Please note that the minimum awarded score based on the WBA performance is 0.39 as no company has achieved the maximum score in the benchmark. Similarly, no company in the sample as received a score of zero by the WBA. A relation between the greenwashing scores and announcement returns is subsequently tested using the corresponding subsamples for which they are available.

4.5 Control variables

Several control variables are needed in order to test the subsequent hypotheses. Concerning all regressions of the CARs (Hypotheses 2–4 and 6), three control variables are included. Firstly, 'ROA' measures firm performance, using the average preceding three-year ROA of the divesting parent. Poorly performing firms have been shown to exhibit higher divestiture announcement returns in previous research (Johnson, 1996). The second factor to be included is the relative size of the sell-off to the market capitalization of the parent. Klein (1986) found this to be a significant positive driver of divestiture announcement returns. To avoid any influence from the divestiture on the market capitalization, the value ten trading days prior to the divestiture is taken, in line with Teschner and Paul (2021). Similar to the research of these authors, dummy variables are created distinguishing between small, medium and large divestitures with thresholds of 10% and 50% for a medium and large classification, respectively. These values take on value 1 if the relative size is smaller than 10 percent for small, greater than or equal to 10 percent, but smaller than 50 percent for medium, and greater than or equal to 50 percent for large. Thirdly, 'Debt-to-equity' is included as this ratio has been found to positively impact announcement returns, consistent with the previously mentioned financing hypothesis of Lang et al. (1995). The value at the end of the preceding fiscal year is included and measured as total long-term debt divided by total shareholders' equity, in line with Brauer and Schimmer (2010).

Additionally, it can be expected that large companies have a higher environmental commitment score, because they possibly experience greater societal or shareholder pressure to make certain commitments and are more likely to be part of certain memberships such as the OGMP. This is tested through the pairwise correlations in Table 21, which indeed shows a significant positive relation between a firm's market capitalization and their environmental commitment score. To account for this size effect, the natural logarithm of the market capitalization is included in the regressions based on the environmental commitment score (i.e., H2 and H4). The log transformation is made to let the model account for percentage increases in size, rather than absolute values and therefore increases ease of interpretation. Year dummies are included here as well as these commitments have risen sharply over time as depicted in Figure 3.

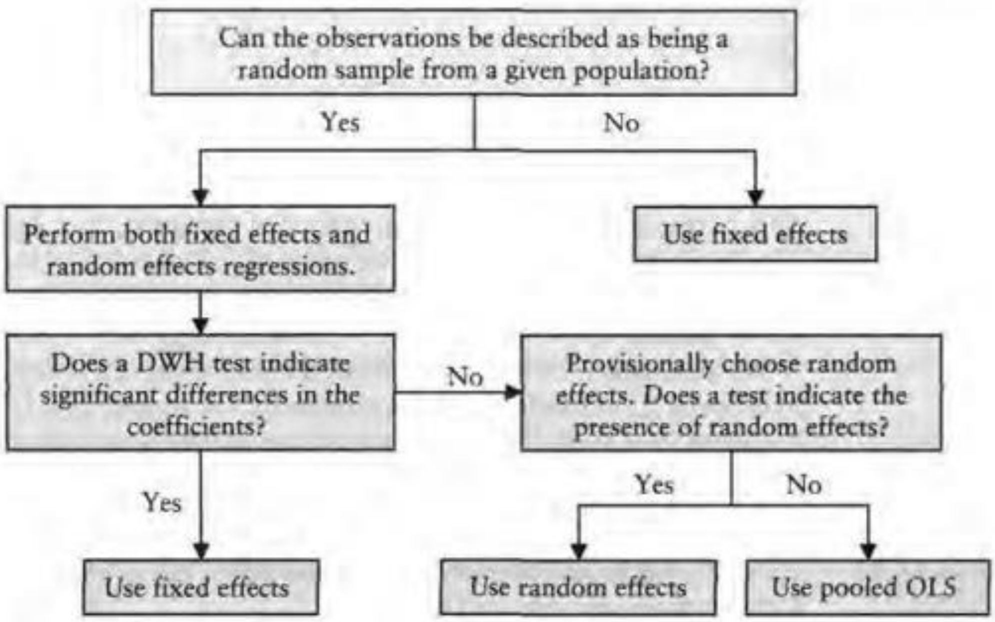
Regarding hypothesis 5 on which assets are acquired by private rather than public companies, it is less obvious which factors correlate with this outcome. The only apparent research into the determinants of private acquisitions focuses on private equity, which constitutes only 12 out of 95 public-to-private divestitures in the studied sample. For example, Gompers et al. (2016) find a strong focus of private equity on buying companies at low valuations and subsequently improving operating performance. Following this reasoning, a low parent company ROA could be a potential driver of the likelihood to be acquired by a private equity firm, assuming a positive correlation between the profitability of the divested asset and its parent. Contrastingly, public oil and gas majors are expected to focus on the highest performing assets, meaning that they might be more likely to acquire assets from well performing companies. Therefore, a negative relation between ROA and an acquirer being private might be expected. For this reason, ROA is included as a control variable. Additionally, under the assumption that the acquiring private oil and gas companies are generally smaller than their public peers, private companies might not be able to acquire assets the same size as public companies. An exception to this could be large, state-owned companies that are larger than many with a public listing (e.g., Saudi Aramco pre-IPO). However, as shown in Table 27 in Appendix A, these only represent 6 out of 95 acquirors. Given that it is certainly imaginable that the size of the asset is related to its SIC classification used as proxy for pollution levels, the control variable 'Deal value' is included. Furthermore, general economic and regulatory factors – such as the growing amount of environmental pressure from shareholders – can be expected to influence this decision. Therefore, year dummies are included. Lastly, since the emissions intensity is based on 4-digit SIC codes, controls for subindustry are included to prevent inclusion of any tendency of private acquirers to buy a certain type of assets.

4.5.1 Panel techniques

The data forms an unbalanced panel of cross-sectional and time-series data. Thus, for the following hypotheses the possibility to use panel approaches other than pooled OLS is examined. Specifically, fixed effects and random effects models. To test the appropriateness of fixed effects, random effects or pooled OLS across the dimensions firm, year, asset subindustry and region, the approach of Dougherty (2011) is followed, graphically represented in Figure 4. If appropriate, a random effects specification yields the most efficient results, since unlike with OLS the effect of unobserved characteristics influencing the independent variable can be modeled, without including the panel variables as regressors as would be the case with fixed effects, maintaining degrees of freedom (Dougherty, 2011). However, two conditions must be met in order to maintain its validity. First, the observations should constitute a random sample from a given population. In principle, this assumption holds when we define the population as all divesting firms during the studied period, as the reasons that led to exclusion of events can be seen as random. However, when defining the population as all oil and gas firms, this assumption is less likely to hold given that the subset of divesting firms differ along certain dimensions from non-divesting firms as covered in section 2.1. In case these dimensions are related to the dependent variables 'CAR' and 'Private acquirer', results from a random effects specification might not be extendable to non-divesting firms. Regardless, it is difficult to see how to draw inferences towards non-divesting firms in any case as they would become part of the divesting group upon asking what firm X's CAR would be if it divested asset Y. Therefore, the answer to the first question in Figure 4 is assumed to be 'Yes'.

Figure 4

Choice of regression model for panel data.



Adapted source: Dougherty, 2011.

Second, the unobserved effect should be distributed independently of the X_i regressors (or at the very least, the one of interest), as a correlation between these effects – which are subsumed in a cluster-specific constant term – and the regressor would bias the coefficients. This form of heterogeneity would cause the independent variables to take on part of the unobserved effects due to multicollinearity. To detect the presence of this heterogeneity, a Hausman (or Durbin-Wu-Hausman, DWH) test is performed. In the case it is found, a fixed effects model is appropriate. Otherwise, a Breusch-Pagan test is performed to test for the presence of random effects, to help decide between a random effects and pooled OLS specification.

4.6 Model specifications

4.6.1 Baseline specifications

Having discussed the significance test of the CARs leading up to equation (5) in section 4.1, this section provides the model specifications for the further hypotheses. An extensive overview of all regression models is reported in Appendix B. Below, I present a subsection including only the baseline specification for each hypothesis, which includes the control variables as specified in section 4.2.

Hypothesis 2

H2: Companies that have made a stronger commitment to reduce greenhouse gas emissions experience similar divestiture announcement returns to those that have not.

$$CAR_i = \alpha + \beta_1 env\_com_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \beta_6 large_i + \varepsilon_i \quad (7)$$

Hypothesis 3

H3: Companies showing better actual environmental performance earn higher divestiture announcement returns than their peers.

This hypothesis is tested based on both the environmental performance as measured by the use of the divestiture proceeds (12) and the company performance score provided by the WBA (16):

$$CAR_i = \alpha + \beta_1 prc\_green_i + \beta_2 prc\_neutral_i + \beta_3 emissions_i + \beta_4 ROA_i + \beta_5 DE_i + \beta_6 medium_i + \beta_7 large_i + \varepsilon_i \quad (12)$$

$$CAR_i = \alpha + \beta_1 perf\_WBA_i + \beta_2 emissions_i + \beta_3 ROA_i + \beta_4 DE_i + \beta_5 medium_i + \varepsilon_i \quad (16)$$

The variable 'large' is omitted here, as no divestitures in the WBA sample have met its threshold of the deal value being 50 percent or more of its parent's market capitalization.

Hypothesis 4

H4: The extent to which companies engage in greenwashing (i.e., the differential between stated environmental commitments and actual performance) has no effect on divestiture announcement returns.

The same applies to the greenwashing scores constructed from the two separate performance scores based on the use of the proceeds (18) and the performance score provided by the WBA (22):

$$CAR_i = \alpha + \beta_1 grw\_prc_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \beta_6 large_i + \varepsilon_i \quad (18)$$

$$CAR_i = \alpha + \beta_1 grw\_WBA_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \varepsilon_i \quad (22)$$

Hypothesis 5

H5: More polluting oil and gas assets are more often divested to private companies compared to other oil and gas assets.

Unlike in the other model specifications, the regression for hypothesis 5 has a binary outcome for the dependent variable, namely whether the acquirer of the asset was publicly listed or not. This means that either a logit or probit model is appropriate as a regression specification. Logit models are generally described as fit for modeling the probability of success regarding a binary variable, whereas probit models are generally used as the probability that the outcome will belong to one of a range of categories (Dougherty, 2011). However, both can be used to estimate the following regression:

$$Private\_acq_i = \alpha + \beta_1 emissions_i + \beta_2 ROA_i + \beta_3 dealvalue_i + \varepsilon_i \quad (25)$$

To test for the appropriateness between the two, Chen and Tsurumi (2010) have suggested the use of the Akaike information criterion (AIC) and Bayesian information criterion (BIC) as being able to choose the correct model better than other criteria. Therefore, I run the above specification in both logit and probit type regressions. Both information criteria provide slightly higher values for the logit model, therefore this specification is chosen. The almost neglectable difference is in line with the expectation that both models behave similarly when the dependent variable is reasonably balanced (i.e., a mean around 0.5). The information criteria are provided in Table 29 in Appendix C.

Hypothesis 6

> *H6: 'Stewardship-at-risk' divestitures earn greater announcement returns compared to other divestitures in the sample.*

$$CAR_i = \alpha + \beta_1 SaR_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 medium_i + \beta_5 large_i + \varepsilon_i \quad (29)$$

This is again an Ordinary Least Squares (OLS) regression, with dummy variable 'SaR' taking on value 1 for stewardship-at-risk transactions where divested assets move to either a private company, or one lacking one or more of the environmental commitments the divesting parent has made.

4.6.2 Testing of panel variables

As discussed in section 4.2.1, for all hypotheses the preferred panel technique(s) are defined along the different possible panel variables. These are: year, firm, subindustry and region. Region is only considered as a possibility in case firm random or fixed effects are rejected, given that no firms in the sample have switched region such that firm unobserved effects automatically include region unobserved effects. An exception is made for the WBA score regressions, where firm effects are not possible to include, because a firm's WBA score does not vary over time and therefore its coefficient has perfect multicollinearity with the fixed effects. Hence, here region fixed/random effects are immediately tested for in equations (8) and (10). The outcome 'Use pooled OLS' in Figure 4.1, could mean that the choice of model is in effect not pooled OLS, but a fixed/random effects model along a different panel variable.

In order to accurately perform the Hausman and Breusch-Pagan tests, the presence of heteroskedasticity is investigated. As testing of heteroskedasticity in random effects models is not straightforward, and involves transformation to a GLS specification, this is approached using a Breusch-Pagan test on heteroskedasticity in the pooled OLS specifications. Heteroskedasticity in the fixed effects specifications is tested using a modified Wald test for groupwise heteroskedasticity in the residuals of a fixed effects model, as suggested by Greene (2000, p. 598). In case either of the two tests detect heteroskedasticity, clustered standard errors are included for the random effects specification. An overview of the according tests is reported in Table 30 in Appendix C. For all fixed effects specifications except for those regarding eq. (8) including region effects, groupwise heteroskedasticity is detected.

With respect to the logit model in eq. (11), quite some discussion exists around the appropriateness of robust standard errors in binary outcome models, as they implicitly assume a certain degree of model misspecification (Giles, 2013). Heteroskedasticity in logit models does not cause coefficients to be biased and is not a violation of the model's underlying assumptions. Therefore, normal standard errors are reported, yielding an accurate description of the underlying data but warranting some caution regarding counterfactual interpretations (Buis, 2010).

Table 4.1 reports the Hausman tests for all hypotheses along the different panel variables, which include clustered standard errors on the fixed and random effects specifications except for 'H3 – WBA' including region effects. This test reports no statistic in case there is no significant variance in the panel specific intercepts, meaning that pooled OLS is appropriate (Schaffer, 2014). For all models except those using the WBA sample, firm fixed effects are appropriate. No other fixed or random effects are detected. However, some are included based on reasoning described in section 4.5.

Table 6

Hausman tests for the linear regression models. This table presents the results of the Hausman or DWH tests for the appropriateness of random versus fixed effects for the linear models along panel variables year, firm and subindustry. The modified Hausman test is used in case of clustered SEs. The Hausman test is automatically not performed in Stata 17 when the Breusch-Pagan test for random effects is insignificant, meaning that no effects are found and Pooled OLS is appropriate. If H_0 is rejected ($p<0.05$), fixed effects are appropriate over random effects.

Hypothesis	Dimension	Test applicable	χ^2 statistic	P-value
H2	Firm	Yes	131.815	0.00
	Year, Subindustry	No, ($\sigma_u = 0$)[1]		
H3 – proceeds	Firm	Yes	76.393	0.00
	Year, Subindustry	No, ($\sigma_u = 0$)[1]		
H3 – WBA	Year, Region, Subindustry	No, ($\sigma_u = 0$)[1]		
H4 – proceeds	Firm	Yes	109.577	0.00
	Year, Subindustry	No, ($\sigma_u = 0$)[1]		
H4 – WBA	Year, Region, Subindustry	No, ($\sigma_u = 0$)[1]		
H6	Firm	Yes	102.215	0.00
	Year, Subindustry	No, ($\sigma_u = 0$)[1]		

[1] σ_u represents the random effects variation, if zero there is no significant variation between clusters.

For the logistic regression in eq. (11), random effects specifications are first tested for significance along the panel variables firm, year and subindustry and region. For this purpose, a likelihood-ratio test is performed on the probability that rho, representing the panel-level variance component, is zero. If this hypothesis is not rejected, the panel estimator is not different from the pooled estimator (StataCorp, 2021). None of the four included random effects prove significant as reported in Table 31 in Appendix C, meaning an ordinary logit regression is performed. However, as explained in section 4.5, year and subindustry dummies are still included to arrive at a closer estimate of the true emissions coefficient.

4.7 Robustness tests

Several robustness tests are performed in order to test the sensitivity of the results to certain assumptions. First, the CARs in the baseline regressions specified above are transformed to a binary variable 'pos_CAR', taking on value 1 if the CAR is positive and 0 otherwise. Subsequently, the regressions are performed again running a logit model, in order to test for an effect of the variables on positive value creation through the divestitures. As a second check, the abnormal returns are re-estimated following the constant mean model instead of using the CAPM calculation of abnormal returns. This is again done following eq. (1), but where expected returns are calculated as:

$$ER_{i,t} = \frac{1}{T_1 - T_0} \sum_{T_0}^{T_1} R_{i,t} \quad (31)$$

over the estimation window $T_1 - T_0$, again the 120 trading days prior to the event window. Thirdly, the regressions are performed again after winsorizing the variables 'ROA' and 'DE', given that quite extreme values exist and the mean and median are quite different, potentially due to skewness from outliers. Winsorizing is done at the 5 and 95 percent levels, whereas for DE only the upper bound is winsorized given the existing minimum of zero. This threshold is chosen due to the size of the sample given that quite extreme values still persist at lower thresholds, as reported in Table 32 in Appendix C. These three tests are performed only for the final, most complete model specification for each of the models that are provided in section 5.1.

Two additional tests are performed specific to hypotheses 3 and 5, respectively. Given that most firms score quite poorly in the WBA performance benchmark, H3 is tested again using a high versus low classification rather than the continuous score. The threshold for receiving a 'high' classification is set at the 75^{th} percentile level. This is done because there is very little variation within this low-scoring group, as Table 5 shows that the 75^{th} percentile WBA performance score in the sample is only 3.50 out of a maximum of 20. Lastly, hypothesis 5 on divestitures to private companies is tested again after the exclusion of the ten investor groups that are currently classified as private, given that they are often consortia of public oil and gas companies and therefore not truly private. The results are reported in section 5.2, whereas all subsequent model specifications continue in the second section of Appendix B. Additional descriptive statistics of the variables created are reported in Table 28 in Appendix A.

CHAPTER 5 Results

5.1 Regression results

Hypothesis 1

H1: Announcement returns on the divestiture announcement date are positive for sell-offs by oil and gas companies.

Table 7 presents the results regarding the first hypothesis. Positive CARs are found at the 5 percent significance level (p-value = 0.046). The average CAR amounts to 1.1 percent over the period [-1, 1] days surrounding the divestiture, as reported in the descriptive statistics in Table 3.

Table 7

Significance of average CAR. This table presents the results of the average CAR across the studied sample. CARs are measured over the period [-1, 1] days surrounding the event date. The figure between parentheses presents the standard error.

	CAR (5)	95% conf. interval
_cons	0.011** (0.005)	0.000 – 0.021
Obs	172	
Root MSE	0.070	

*** p<0.05*

Hypothesis 2

H2: Companies that have made a stronger commitment to reduce greenhouse gas emissions experience similar divestiture announcement returns to those that have not.

The regression results are reported in Table 8. Without including control variables, model (6) shows a clear negative relation between the CARs and companies' environmental commitment scores 'env_com'. Having made one additional commitment of the four included in this variable is associated with earning a 0.9 percentage point lower announcement return. However, this seems mostly due to divestitures by companies scoring high on environmental commitments being smaller in terms of relative size to their parents' market capitalization. This is confirmed by the positive correlation between 'small' (deal value < 10 percent of market capitalization) and 'env_com' in Table 21 in Appendix A. Upon including the relative size dummies as explained in section 4.5, along with the other control variables, the relation between CARs and environmental commitments disappears. Model (7) logically shows that 'large' divestitures (where deal value ≥ 50 percent of market capitalization) experienced a 13.3 percentage point higher CAR as compared to 'small' divestitures, significant at the 5 percent level. The initial negative relation between the environmental commitment score and CARs can be linked to the previously explained effect of larger companies scoring higher on environmental commitments (e.g., due to more societal or shareholder pressure), who are also more inclined to undertake these 'small' divestitures, significant at the 1 percent level as shown in Table 21. The distinction between 'medium' (10 to 50 percent of market capitalization) and 'small' divestitures however does not relate to the CARs significantly, unlike in the research of Teschner and Paul (2021), who studied sell-offs across industries in the DACH region.

Furthermore, no coefficient for 'large' can be estimated in firm fixed effects models (8) and (9) because no company that announced a 'large' divestiture has also announced a 'small' or 'medium' divestiture, creating perfect multicollinearity between variable 'large' and the firm identifiers. An increase in the level of debt by the amount of book equity (i.e., adding 1 to the D/E multiple) in these specifications is associated with a 3.8 percentage point higher announcement return, significant at the 1 percent level. This is consistent with the aforementioned financing hypothesis of Lang et al. (1995), arguing that divestitures relaxing financing constraints for firms with a high debt burden are often the only source of financing for positive NPV projects. Additionally, potential underinvestment in other divisions could be resolved. After including fixed effects, still no significant relation between the environmental commitment score and CARs remains, although the coefficient remains slightly negative at -0.2 percentage points in model (9).

Table 8

Results environmental commitments. This table presents the results of the CAR OLS regressions on companies' environmental commitment scores 'env_com', along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end. 'mktcapb' presents the market capitalization in USD billions, 'medium' and 'large' are dummies for the relative size of the divestitures to their parent's market capitalization. The figures between parentheses present robust (clustered by firm in case of fixed effects) standard errors. The within R^2 is reported for the fixed effects regressions (8) and (9).

	CAR (6)	CAR (7)	CAR (8)	CAR (9)
env_com	-0.009***	-0.001	-0.006	-0.002
	(0.003)	(0.003)	(0.004)	(0.006)
ROA		0.006	0.008	0.002
		(0.112)	(0.104)	(0.100)
DE		0.000	0.038***	0.038***
		(0.001)	(0.004)	(0.004)
ln(mktcapb)		-0.006	0.001	-0.012
		(0.005)	(0.011)	(0.012)
medium		-0.005	0.010	0.006
		(0.014)	(0.020)	(0.022)
large		0.133**	*omitted*	*omitted*
		(0.060)		
_cons	0.017**	0.022	-0.051	-0.012
	(0.007)	(0.017)	(0.034)	(0.038)

Table 8 - Continued				
Firm fixed effects	No	No	Yes	Yes
Year fixed effects	No	No	No	Yes
Obs	172	172	172	172
R^2	0.021	0.298	0.320	0.339
Adj. R^2	0.015	0.272	0.300	0.302

**** p<0.01, ** p<0.05, * p<0.10*

Hypothesis 3

H3: Companies showing better actual environmental performance earn higher divestiture announcement returns than their peers.

The results of the CAR regressions on both environmental performance metrics are reported in Table 9. As was the case with a high environmental commitment score, a 'prc_green' classification based on the use of proceeds – i.e., investing the proceeds in a green category as detailed in Table 4 in section 3.3 – initially is associated with lower announcement returns. In model (10), divestitures in this category earned on average 3.7 percentage points lower CARs around the event date as compared to the reference category of brown uses, significant at the 5 percent. This brown category consists mainly of pledges to invest proceeds in core oil and gas projects. In specification (10), 'prc_green' also earned 2.6 percentage point lower returns compared to 'prc_neutral' (p-value = 0.054, not tabulated), where proceeds are often used to repay debt or make dividend payments. These figures are quite economically significant, given the average announcement return being only 1 percent. However, the significance disappears again after including control variables in model (12) (p-value = 0.109) and 'prc_green' nears zero upon inclusion of firm fixed effects in model (13). Interestingly, the difference between brown and green uses of proceeds in model (10) has a similar effect in size to that between a maximum (4) and minimum (0) environmental commitment score in model (6), at -3.7 versus -3.6 percentage points. This would suggest that the market differentiates little between commitments and actual performance, if these results had not suffered from omitted variable bias.

Furthermore, the carbon intensity presented by 'emissions' does not significantly relate to the announcement returns in any of the specifications, whereas other control variables in panel A behave similarly to those in Table 8. Interestingly, the adjusted R^2 drops significantly from 0.302 to -0.286 after including firm fixed effects in model (13), unlike in the regressions on the environmental commitment scores. This means that the model fit is very poor due to the large number of additional constraints imposed by the fixed effects, which include 68 firms. Model (12) is therefore the preferred specification, providing slight but insignificant evidence for a negative value effect of environmental performance through uses of the proceeds along the pooled data. Note that 18 observations are deleted across all models in panel A due to the absence of a press release stating the intended use of proceeds, as detailed in section 3.3.

Table 9

Results environmental performance. This table presents the results of the CAR OLS regressions on environmental performance variables, along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. 'prc_green' and 'prc_neutral' represent dummy variables for green and neutral uses of the proceeds, against the reference category 'brown', whereas 'emissions' represents the carbon intensity in kg CO_2/USD revenue. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end. 'medium' and 'large' are dummies for the relative size of the divestitures to their parent's market capitalization. 'perf_WBA' represents the performance score provided by the WBA. In panel B, 'large' is omitted since no divestitures in this sample meet this size threshold. The figures between parentheses present the standard errors. Robust (clustered in case of fixed effects) standard errors are reported in panel A and normal standard errors in panel B.

Panel A: Performance based on use of proceeds

	CAR (10)	CAR (11)	CAR (12)	CAR (13)
prc_green	-0.037**	-0.034**	-0.023	0.000
	(0.016)	(0.016)	(0.014)	(0.015)
prc_neutral	-0.010	-0.010	-0.013	0.007
	(0.013)	(0.013)	(0.011)	(0.011)
emissions		0.007	0.009	-0.002
		(0.006)	(0.006)	(0.009)
ROA			0.037	0.014
			(0.104)	(0.129)
DE			0.001	0.038***
			(0.001)	(0.006)
medium			0.012	0.014
			(0.011)	(0.014)
large			0.178***	*omitted*
			(0.059)	
_cons	0.021**	0.016	0.001	-0.056***
	(0.011)	(0.012)	(0.008)	(0.014)
Firm fixed effects	No	No	No	Yes
Obs	154	154	154	154
R^2	0.019	0.023	0.334	0.328
Adj. R^2	0.006	0.003	0.302	-0.286

Panel B: Performance based on WBA performance score

	CAR (14)	CAR (15)	CAR (16)
perf_WBA	0.000	0.000	-0.001
	(0.002)	(0.002)	(0.002)
emissions		0.001	0.001
		(0.005)	(0.005)
ROA			0.092
			(0.067)
DE			0.007
			(0.009)
medium			0.011
			(0.012)
_cons	-0.004	-0.005	-0.009
	(0.008)	(0.008)	(0.010)
Firm fixed effects	No	No	No
Obs	147	147	147
R^2	0.000	0.001	0.018
Adj. R^2	-0.007	-0.013	-0.017

**** p<0.01, ** p<0.05, * p<0.10*

Panel B of Table 9 reports the results regarding the WBA sample. Both before and after inclusion of the specified control variables, no relation between the performance score and announcement returns is found. Interestingly, also the control variables are insignificant in this sample. A potential explanation for this lies in the relative size of these divestitures to their parents' market capitalization being only 2.3 percent against 13.9 percent in the main sample. This consequently leads to slightly negative mean and median CARs as reported in Table 22 in Appendix A. Conclusively, it appears difficult to draw inferences from this sample as most divestitures did not have a significant impact on the companies' share price. The adj. R^2 remaining below zero shows that other, non-included (and potentially unrelated to the divestiture and its characteristics) factors have been the most important drivers of the abnormal returns in the parents' share prices. No 'large' divestitures (50 percent of market capitalization or over) have occurred within the sample covered by the WBA, meaning this variable is dropped in panel B.

Hypothesis 4

> *H4: The extent to which companies engage in greenwashing (i.e., the differential between stated environmental commitments and actual performance) has no effect on divestiture announcement returns.*

Table 10 presents the regression results regarding the greenwashing coefficients. As hypothesized, no relation is found between the greenwashing coefficients and the announcement returns in both samples. Interestingly, in panel A the coefficient switches signs upon including firm fixed effects, showing a tendency towards 3.3 percentage point higher returns for firms with the maximum versus minimum greenwashing score in model (18) (p-value = 0.132), which turns negative though still insignificant for within firm variation in degree of greenwashing. Therefore, a seemingly positive effect is largely due to excluded firm factors correlated with the greenwashing coefficient, such as firm size. The control variables behave similarly as in previous specifications using this sample. The only exception is the market capitalization, which has a significant negative relation with CAR in model (18), to the extent of -0.009 percentage point for a one percent increase in size. Potentially, this happens because more factors unrelated to the divestiture influence the share price for larger firms, reverting the CARs to zero. Alternatively, it likely captures part of the variation in relative size of the divestitures within the boundaries of the size dummies, creating lower returns for larger firms. Panel B again shows there are no significant coefficients among the WBA sample, which is not surprising given that the greenwashing score is based on the same metric and sample as described for the previous hypothesis.

Table 10

Results greenwashing. This table presents the results of the CAR OLS regressions on greenwashing coefficients, along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. 'grw_prc' and 'grw_wba' represent the greenwashing scores based on the use of proceeds and WBA score, respectively. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end. 'mktcapb' presents the market capitalization in USD billions, 'medium' and 'large' are dummies for the relative size of the divestitures to their parent's market capitalization. In panel B, 'large' is omitted since no divestitures in this sample meet this size threshold. The figures between brackets present the standard errors. Robust (clustered by firm in case of firm fixed effects) standard errors are reported in both panels. The within R^2 is reported for the fixed effects regressions (19), (20) and (23).

Panel A: Greenwashing score based on use of proceeds

	CAR	CAR	CAR	CAR
	(17)	(18)	(19)	(20)
grw_prc	-0.005	0.033	-0.022	-0.011
	(0.020)	(0.022)	(0.018)	(0.019)
ROA		0.048	0.027	0.002
		(0.109)	(0.104)	(0.106)
DE		0.000	0.038***	0.038***
		(0.001)	(0.004)	(0.004)
ln(mktcapb)		-0.009*	0.002	-0.011
		(0.005)	(0.013)	(0.014)
medium		-0.005	0.013	0.005
		(0.015)	(0.024)	(0.026)
large		0.144**	*omitted*	*omitted*
		(0.064)		
_cons	0.015	0.017	-0.051	-0.012
	(0.011)	(0.019)	(0.038)	(0.042)
Firm fixed effects	No	No	Yes	Yes
Year fixed effects	No	No	No	Yes
Obs	154	154	154	154
R^2	0.000	0.335	0.331	0.352
Adj. R^2	-0.006	0.308	0.308	0.312

Panel B: Greenwashing score based on WBA performance score

	CAR	CAR	CAR
	(21)	(22)	(23)
grw_WBA	0.000	0.005	0.025
	(0.018)	(0.019)	(0.027)
ROA		0.105	0.128
		(0.082)	(0.090)
DE		0.005	0.009
		(0.008)	(0.010)
ln(mktcapb)		-0.004	-0.006
		(0.005)	(0.005)
medium		0.007	0.006
		(0.023)	(0.024)
_cons	-0.005	0.007	0.005
	0.012	(0.023)	(0.024)
Firm fixed effects	No	No	No
Year fixed effects	No	No	Yes
Obs	147	147	147
R^2	0.000	0.027	0.042
Adj. R^2	-0.007	-0.007	-0.021

**** p<0.01, ** p<0.05, * p<0.10*

Hypothesis 5

H5: More polluting oil and gas assets are more often divested to private companies compared to other oil and gas assets.

The results regarding hypothesis 5 are reported in Table 11. The emissions coefficient remains positive across specifications, but is insignificant with 2-sided p-values (because an opposite effect cannot be ruled out) ranging from 0.218 in model (27) to 0.300 in model (25). Only the deal value is significantly related to whether or not an acquiring company is private, at the 5 percent level. An increase in deal value of 1 billion USD is associated with a $1 - e^{-0.198} = 18.0$ percent reduction in the relative likelihood of divesting to a private acquirer in the final specification (27). The pseudo R^2 of 0.028 in this specification signifies that the vast majority of variance among outcomes cannot be explained by the parameters included in these models, meaning that potential explanatory variables might be omitted, or that the dependent variable could be randomly distributed in general. It is however true that in the observed sample, an increase in carbon intensity of 1 kg per USD in revenue (circa 1.46 standard deviation) has on average led to an $e^{0.36} - 1 = 43.3$ percent increase in the relative likelihood of divesting to a private company. However, when seen as a random sample, the chance of observing this outcome while no effect exists in the population is equal to the coefficient's p-value of 21.8 percent, meaning that this result is not necessarily valid and the hypothesis is rejected. This hypothesis is tested using an extended sample of 241 observations, where amongst others divestitures with confounding events are added back, as detailed in section 3.1.1. This is done because confounding events may bias the CAR regressions as they impact the share price, but should not have an impact on divesting to a publicly versus privately owned entity.

Table 11

Emissions relation with private acquirer. This table presents the results of the logit regressions of 'private_acq' on 'emissions', along with several control variables. 'private_acq' takes on value 1 for divestitures to a private company, 'emissions' represents the carbon intensity in kg CO_2/USD revenue and 'ROA' is the average ROA over the 3 years preceding the divestiture. 'dealvalue' represents total consideration for the divestiture in USD billions. The figures between parentheses present normal standard errors. LLF presents the log likelihood function.

	private_acq (24)	private_acq (25)	private_acq (26)	private_acq (27)
emissions	0.275	0.266	0.268	0.360
	(0.251)	(0.257)	(0.256)	(0.292)
ROA		0.080	-0.288	-0.361
		(1.963)	(2.080)	(2.158)
dealvalue		-0.177**	-0.187**	-0.198**
		(0.088)	(0.091)	(0.094)
_cons	0.028	0.221	0.244	-0.109
	(0.207)	(0.227)	(0.331)	(0.621)
Year fixed effects	No	No	Yes	Yes
Subindustry fixed effects	No	No	No	Yes

Table 11 - Continued				
Obs	241	241	241	241
Pseudo R^2	0.004	0.021	0.023	0.028
LLF	-165.097	-162.343	-161.891	-161.101
AIC	334.193	332.686	339.783	344.203

**** p<0.01, ** p<0.05, * p<0.10*

Hypothesis 6

H6: 'Stewardship-at-risk' divestitures earn greater announcement returns compared to other divestitures in the sample.

Lastly, the results regarding potential arbitrage opportunities through 'stewardship-at-risk' divestitures are reported in Table 12. No significant effect is found regarding the variable of interest 'SaR', meaning that divestitures to either private acquirers or companies lacking one or more of the divesting firm's environmental commitments earn similar announcement returns to more 'environmental reporting-friendly' transactions. Possibly, this relates to the previous finding that private acquirers have a lower propensity to spend large amounts on acquisitions, which could counteract the hypothesized effect in case private acquirers pay a lower acquisition price across the whole range of deal values.

Table 12

Stewardship-at-risk relation with CARs. This table presents the results of the CAR OLS regressions on the binary variable 'SaR', along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. 'SaR' takes on value 1 for 'stewardship-at-risk' divestitures. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end. 'mktcapb' presents the market capitalization in billions USD and 'medium' and 'large' are dummies for the relative size of the divestitures to their parent's market capitalization. The figures between parentheses present robust (clustered in case of fixed effects) standard errors. The within R^2 is reported for the fixed effects regression (30).

	CAR (28)	CAR (29)	CAR (30)
SaR	-0.002	0.012	-0.007
	(0.015)	(0.014)	(0.010)
ROA		0.005	0.031
		(0.112)	(0.094)
DE		0.001	0.038***
		(0.001)	(0.004)
medium		0.012	0.012
		(0.011)	(0.022)
large		0.180***	*Omitted*
		(0.060)	
_cons	0.015	-0.011	-0.048***
	(0.013)	(0.012)	(0.011)
Firm fixed effects	No	No	Yes
Obs	154	154	154
R^2	0.000	0.321	0.327
Adj. R^2	-0.006	0.298	0.309

**** p<0.01, ** p<0.05, * p<0.10*

5.2 Robustness test results

The robustness tests are divided into two parts: In section 5.2.1, the CARs are transformed to a binary variable ‘pos_CAR’ and a mean estimated abnormal return ‘mean_CAR’ as described in section 4.7. The third model in each table or panel includes the winsorized values for ‘ROA’ and ‘Debt-to-equity’, named ‘ROA_w’ and ‘DE_w’. Section 5.2.2 reports the results of hypothesis specific robustness tests as described in section 4.7.

5.2.1 General tests

This section provides a per hypothesis overview of the robustness tests described in section 4.7. Hypothesis 1 is tested again after using the constant mean model for estimating expected returns. The average CAR using these returns as benchmark is slightly lower at 1.0 percent against 1.1 percent before, significant at the 10 percent level. The statistics are presented in Table 33 in Appendix C.

Results for the second hypothesis are presented in Table 13. All logit models, including specification (32) are reported with normal standard errors following prior reasoning. Furthermore, for these binary outcome models a large amount of observations is deleted when including firm fixed effects. This is due to these firms having no variation in positive versus negative CARs (i.e., in ‘pos_CAR’), meaning none of the regressors can predict a change in outcome. The results for hypothesis 2 are similar to the main regression (9), with the exception of the natural logarithm of market capitalization now showing a significant negative coefficient in model (33), at the 10 percent level. No inferences about any relation between the environmental commitment score ‘env_com’ and either the height or direction of CARs can be made. Furthermore, the coefficient for ‘DE’ almost doubles after winsorizing (model 34), signaling concavity in the CARs for very high values. These are cut off due to winsorizing and given less weight as they are brought towards the center. This means that a positive relation with CAR becomes lower (potentially negative) at very large values of ‘DE’, which is in line with a decrease in bargaining power when the divesting firm is in distress. However, winsorizing decreases the adjusted R^2 steeply from 0.302 in model (9) to 0.145 in (34), meaning the specification is a worse fit for the data. All results for the WBA sample remain insignificant and are therefore reported in Table 34 in Appendix C.

Table 13

Robustness results environmental commitments. This table presents the results of the robustness tests on the CAR regressions on companies' environmental commitment scores 'env_com', along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. Model (32) is a logit regression on positive value creation 'pos_CAR', models (33) and (34) are OLS regressions on CARs using the constant mean method 'mean_CAR', and the prior 'CAR'. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end (suffix _w signifies the winsorized variable). 'mktcapb' presents the market capitalization in USD billions. 'medium' is a dummy for the relative size of the divestitures to their parent's market capitalization whereas 'large' is omitted due to multicollinearity with firm fixed effects. The figures between parentheses present normal standard errors for (32), and clustered by firm for (33) and (34). The pseudo R^2 is reported for the logit model, the within R^2 for the fixed effects regressions (33) and (34). No goodness-of-fit measure for the logistic model is reported given a lack of comparability to the other models' adj. R^2.

	pos_CAR (32)	mean_CAR (33)	CAR (34)
env_com	-0.491	-0.001	-0.003
	(0.548)	(0.006)	(0.006)
ROA	1.734	-0.019	
	(12.740)	(0.084)	
ROA_w			-0.112
			(0.139)
DE	1.162	0.037***	
	(1.285)	(0.004)	
DE_w			0.066*
			(0.037)
ln(mktcapb)	-0.820	-0.028*	-0.013
	(1.073)	(0.015)	(0.012)
medium	-1.669	0.005	0.003
	(1.039)	(0.020)	(0.022)
_cons	0.017**	0.037	0.012
	(0.007)	(0.048)	(0.046)
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Obs	107	172	172
R^2	0.122	0.321	0.190
Adj. R^2	n.a.	0.283	0.145

*** *p<0.01*, ** *p<0.05*, * *p<0.10*

Table 14 presents the robustness test results for hypothesis 3 on environmental performance. Interestingly, in model (35) both 'prc_green' (though only as opposed to neutral) and 'emissions' are strongly negatively related to whether or not a divestiture earns positive CARs, at the 5 percent significance level. Stating to invest the proceeds in a green category rather than neutral, decreases the odds of positive abnormal returns by $1 - e^{-2.964}$ = 94.8 percent. Similarly, an increase in carbon intensity by 1 kg per USD revenue decreases the odds by 93.4 percent. When regarding a divestiture of a highly emitting asset as good for company performance, both point in the direction of negative returns related to performance. However, due to the 67 dropped observations in this model, a relatively small amount of eight 'green' divestitures remain (out of 12 initially), of which two have positive CARs. Due to the small sample, the external validity of these outcomes might be limited. Model (36) furthermore shows that without firm fixed effects, these results do not hold. However, the LLF drops significantly in this model, suggesting that excluded firm factors explain important variation in the outcome. Inclusion thus creates a better estimate of the coefficients due to potential elimination of omitted variable bias.

Table 14

Robustness results environmental performance. This table presents the results of the robustness tests on the CAR regressions on companies' environmental performance scores, along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. Models (35) and (36) are logit regressions on positive value creation 'pos_CAR', (37) and (38) are OLS regressions on CARs using the constant mean method 'mean_CAR', and the prior 'CAR'. 'prc_green', 'prc_neutral' and 'prc_brown' represent dummy variables for green, neutral and brown uses of the proceeds, whereas 'emissions' represents the carbon intensity in kg CO_2/USD revenue. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end (suffix _w signifies the winsorized variable). 'medium' and 'large' are dummies for the relative size of the divestitures to their parent's market capitalization. Except in (36), 'large' is omitted due to multicollinearity with firm fixed effects. The figures between parentheses present normal standard errors for (35) and (36), and clustered by firm for (37) and (38). The pseudo R^2 is reported for the logit models, the within R^2 for the fixed effects regressions (37) and (38). The LLF is reported as goodness-of-fit measure for the logistic models, adj. R^2 for the OLS models.

	pos_CAR (35)	pos_CAR (36)	mean_CAR (37)	CAR (38)
prc_green	-2.964**	-0.852	-0.009	-0.005
	(1.354)	(0.648)	(0.018)	(0.017)
prc_neutral			0.020	-0.001
			(0.013)	(0.012)
prc_brown	-1.280	0.315		
	(0.843)	(0.354)		
emissions	-2.722**	0.196	0.000	-0.010
	(1.135)	(0.286)	(0.010)	(0.010)
ROA	-0.780	0.787	-0.071	
	(11.531)	(2.649)	(0.150)	
ROA_w				0.028
				(0.170)
DE	-1.020	0.003	0.037***	
	(1.548)	(0.028)	(0.007)	
DE_w				0.072***
				(0.021)
medium	-1.566	-0.239	0.018	0.018
	(1.091)	(0.388)	(0.017)	(0.016)
large		1.995*		
		(1.010)		
_cons	2.681	-0.104	-0.065***	-0.044**
	(1.948)	(0.330)	(0.018)	(0.019)
Firm fixed effects	Yes	No	Yes	Yes
Obs	87	154	154	154
R^2	0.172	0.050	0.275	0.164
Adj. R^2	n.a.	n.a.	-0.390	-0.600
LLF	-49.538	-101.196	n.a.	n.a.

*** *p<0.01, ** p<0.05, * p<0.10*

Table 15 presents the results regarding the robustness tests on the greenwashing coefficient based on the use of proceeds. The coefficient remains highly insignificant and does not point to any particular direction. Therefore, greenwashing does not appear to have any effect on announcement returns throughout this study. Market capitalization again is negatively associated with CARs measured by the constant mean model (40) and other control variables behave similar to before. Results for the WBA sample are insignificant and reported in panel B of Table 34 in Appendix C.

Table 15

Robustness results greenwashing. This table presents the results of the robustness tests on the CAR regressions on greenwashing score based on the use of proceeds, 'grw_prc', along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. Model (39) is a logit regression on positive value creation 'pos_CAR', models (40) and (41) are OLS regressions on CARs using the constant mean method 'mean_CAR', and the prior 'CAR'. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end (suffix _w signifies the winsorized variable). 'mktcapb' presents the market capitalization in USD billions. 'medium' is a dummy for the relative size of the divestitures to their parent's market capitalization whereas 'large' is omitted due to multicollinearity with firm fixed effects. The figures between parentheses present normal standard errors for (39), and clustered by firm for (40) and (41). The pseudo R^2 is reported for the logit model, the within R^2 for the fixed effects regressions (40) and (41). No goodness-of-fit measure for the logistic model is reported given a lack of comparability to the other models' adj. R^2.

	pos_CAR (39)	mean_CAR (40)	CAR (41)
grw_prc	0.470	-0.002	-0.002
	(1.625)	(0.031)	(0.019)
ROA	2.185	-0.009	
	(14.115)	(0.086)	
ROA_w			-0.087
			(0.136)
DE	0.923	0.038***	
	(1.355)	(0.004)	
DE_w			0.076*
			(0.041)
ln(mktcapb)	-1.225	-0.037*	-0.015
	(1.278)	(0.019)	(0.014)
medium	-1.713	0.003	0.000
	(1.134)	(0.025)	(0.027)
_cons	3.770	0.058	0.003
	(6.205)	(0.050)	(0.049)
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Obs	87	154	154
R^2	0.101	0.342	0.219
Adj. R^2	n.a.	0.301	0.170

**** p<0.01, ** p<0.05, * p<0.10*

Table 16 presents the robustness test results for the final hypothesis. All models show negative but insignificant coefficients for 'SaR' as in the prior firm fixed effects specification (30), meaning that no support for any arbitrage opportunities from divesting to firms with lower environmental commitments is found in this study.

Table 16

Robustness results ‘Stewardship-at-risk’ transactions. This table presents the results of the robustness tests on the CAR regressions on binary variable ‘SaR’, along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. Model (42) is a logit regression on positive value creation ‘pos_CAR’, models (43) and (44) are OLS regressions on CARs using the constant mean method ‘mean_CAR’, and the prior ‘CAR’. ‘SaR’ takes on value 1 for ‘stewardship-at-risk’ divestitures. ‘ROA’ is the average ROA over the 3 years preceding the divestiture and ‘DE’ is the debt-to-equity ratio using book values of the preceding fiscal year-end (suffix _w signifies the winsorized variable). ‘medium’ is a dummy for the relative size of the divestitures to their parent’s market capitalization whereas ‘large’ is omitted due to multicollinearity with firm fixed effects. The figures between parentheses present normal standard errors for (42), and clustered by firm for (43) and (44). The pseudo R^2 is reported for the logit model, the within R^2 for the fixed effects regressions (43) and (44). No goodness-of-fit measure for the logistic model is reported given a lack of comparability to the other models’ adj. R^2.

	pos_CAR (42)	mean_CAR (43)	CAR (44)
SaR	-0.157	-0.011	-0.004
	(0.743)	(0.011)	(0.010)
ROA	2.552	-0.027	
	(10.578)	(0.100)	
ROA_w			0.004
			(0.124)
DE	0.417	0.036***	
	(1.141)	(0.004)	
DE_w			0.069
			(0.046)
medium	-1.714	0.014	0.014
	(1.097)	(0.021)	(0.023)
_cons	-0.766	-0.044***	-0.045
	(1.494)	(0.012)	(0.041)
Firm fixed effects	Yes	Yes	Yes
Obs	87	154	154
R^2	0.076	0.256	0.152
Adj. R^2	n.a.	0.236	0.129

**** p<0.01, ** p<0.05, * p<0.10*

Conclusively, transformation of the CARs to a binary variable, as well as to a mean estimated abnormal return does not meaningfully influence the results of this study. The only exception is the finding that stating to invest divestiture proceeds in a green labelled category drastically lowers the likelihood of achieving positive abnormal returns, to the extent of almost 95 percent. In this same specification, an increase in emissions by 1 kg per USD in revenue has a similar effect in terms of size and statistical significance. These results show that green activity at the firm level is punished both when investing divestiture proceeds in green assets and divesting of brown assets. This is in line with an emissions discount, where high carbon intensity assets are difficult to sell and thus receive a lower price, whereas green investments might be considered overly expensive by the market as compared to ‘neutral’ uses (e.g., dividends or debt repayments). However, this last result is based on a relatively small sample of 87 firms of which only 8 have announced ‘green’ intended uses. These results do not hold without firm fixed effects or when including a continuous CAR as dependent variable. Lastly, winsorizing of 'ROA' and 'Debt-to-equity' does not significantly influence any of the coefficients of interest, and lowers the fit of the models considerably.

5.2.2 Specific tests

For the first hypothesis-specific test, the divestitures in the WBA sample are divided into quartiles by WBA performance score. All divestitures of companies with a score of 3.5 and higher are part of the top quartile, totaling 30 events. Effectively, this constitutes slightly above 20 percent of the sample due to a large number of divestitures scoring exactly one decimal lower. Subsequently, regressions with equal specifications are performed, except now with the binary variable 'high_WBA' (taking on value 1 for the top quartile and 0 otherwise) as independent variable of interest. The results, reported in Table 17 remain similar to before, meaning that the model fits the data very poorly and no significant coefficients arise.

Table 17

Results high WBA performance. This table presents the results of the CAR OLS regressions on 'high_WBA', along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. 'high_WBA' takes on value 1 for the top quartile of divestitures by WBA performance score, whereas 'emissions' represents the carbon intensity in kg CO_2/USD revenue. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end. 'medium' is a dummy for the relative size of the divestitures to their parent's market capitalization against reference category 'small' ('large' is omitted since no divestitures in this sample meet this size threshold). The figures between parentheses present robust standard errors for model (45) and normal standard errors otherwise.

	CAR (45)	CAR (46)	CAR (47)
high_WBA	0.000	0.000	0.000
	(0.005)	(0.007)	(0.007)
emissions		0.001	0.001
		(0.005)	(0.005)
ROA			0.087
			(0.065)
DE			0.006
			(0.009)
medium			0.012
			(0.012)
_cons	-0.005	-0.006	-0.011
	(0.003)	(0.005)	(0.007)
Firm fixed effects	No	No	No
Obs	147	147	147
R^2	0.000	0.001	0.018
Adj. R^2	-0.007	-0.013	-0.018

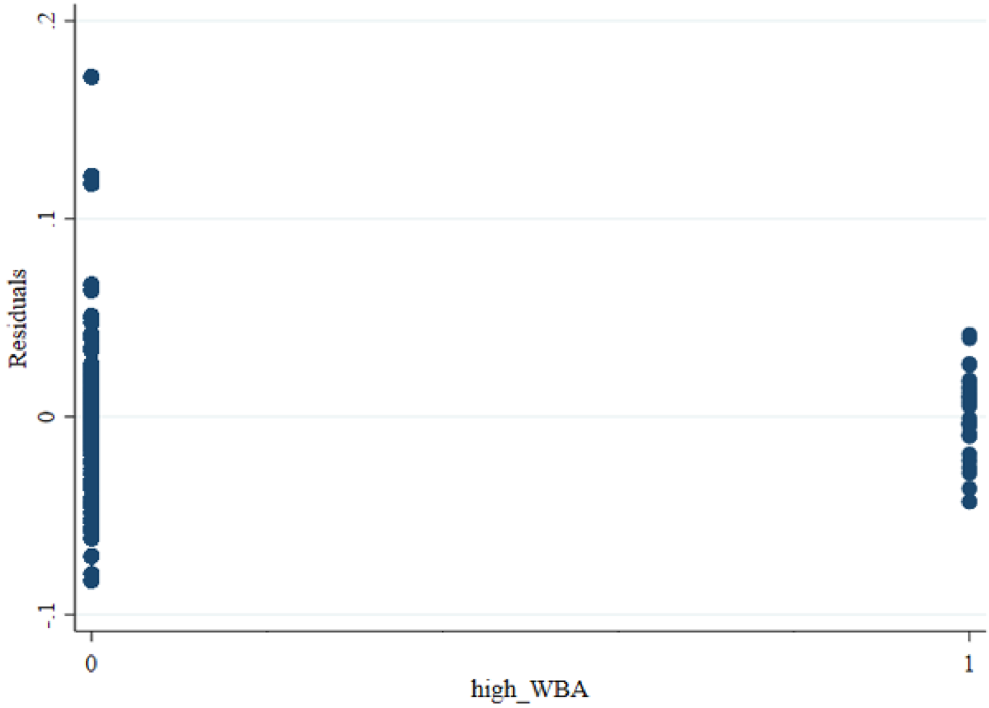
**** p<0.01, ** p<0.05, * p<0.10*

Thus, no inferences can be made regarding any effect of environmental performance as measured by the WBA score on divestiture announcement returns throughout this study. Multiple explanations arise, including the possibility that simply no effect exists. This could be due to the fact that this performance score is not released at the time of divestiture, in contrast to the use of proceeds, and therefore is already incorporated in the share price. Alternatively, the WBA assessment is based on data from 2019 and 2020, meaning it (or essentially, its ranking) is possibly not fully representative for other years, and therefore attenuating a potential effect. However, this seems unlikely to be the main factor given the very small coefficients for both 'perf_WBA' and 'high_WBA' across specifications. Quite possibly, the sample includes too few significant events that influence the share price, as evidenced by the negative mean and median CARs in Table 22. Variation could therefore be largely unrelated to the divestitures and difficult to explain through their characteristics.

However, upon investigating the residuals of model (47) along the variable of interest, a clear difference in variance exists between the top quartile and the bottom 75 percent as shown in Figure 5. A Breusch-Pagan heteroskedasticity test on a regression of the residuals on 'high_WBA' reveals a difference in variance at the 1 percent significance levels ($X^2 = 6.88$). The variance as measured by the mean squared residual is 2.92 times as large for the reference group as is the case in the high performance group (i.e., 'high_WBA' = 1), as reported in Table 35 in Appendix C. This suggests that scoring high on performance is strongly negatively related to share price volatility around the announcement date, and is thus in line with previous research linking ESG performance to a reduction in firm risk (Gillan et al., 2021).

Figure 5

Residuals of model specification (47) plotted against WBA performance. 'high_WBA' is a dummy variable taking on value 1 for the top quartile of divestitures by WBA performance score in the sample of 147 events, and 0 otherwise.



Lastly, Table 18 shows the results regarding the public-to-private divestitures, running the same models again after excluding 10 investor groups that were previously included as private buying entities. The fit of the models increases, given that the LLF values are higher for each model after deleting the investor groups, whereas the new AIC levels are lower in the new sample, both indicating better fit. For example, in model (27), AIC decreases from 344.203 to 330.253, whereas LLF increases from -161.101 to -154.126 after excluding investor groups. The size of the coefficient 'emissions' decreases somewhat in model (27) below. A 1 kg increase in emissions intensity has on average increased the odds of divesting to a private parent by $e^{0.295} - 1 =$ 34.4 percent, versus 43.3 percent previously. However, this figure remains insignificant, meaning a potential effect cannot be isolated.

Table 18

Emissions relation with private acquirer. This table presents the results of the logit regressions of 'private_acq' on 'emissions', along with several control variables. 'private_acq' takes on value 1 for divestitures to a private company, 'emissions' represents the carbon intensity in kg CO_2/USD revenue and 'ROA' is the average ROA over the 3 years preceding the divestiture. 'dealvalue' represents total consideration for the divestiture in USD billions. The figures between parentheses present normal standard errors. LLF presents the log likelihood function.

	private_acq (24)	private_acq (25)	private_acq (26)	private_acq (27)
emissions	0.314	0.317	0.309	0.295
	(0.276)	(0.287)	(0.285)	(0.307)
ROA		-0.015	-0.453	-0.208
		(1.972)	(2.098)	(2.171)
dealvalue		-0.239**	-0.250**	-0.264**
		(0.108)	(0.111)	(0.115)
_cons	-0.075	0.160	0.137	-0.111
	(0.221)	(0.244)	(0.349)	(0.629)
Year fixed effects	No	No	Yes	Yes
Subindustry fixed effects	No	No	No	Yes
Obs	231	231	231	231
Pseudo R^2	0.005	0.028	0.035	0.035
LLF	-158.916	-155.157	-154.757	-154.126
AIC	321.832	318.314	325.515	330.253

**** p<0.01, ** p<0.05, * p<0.10*

CHAPTER 6 Conclusion

The oil and gas industry needs to undergo drastic changes in order to align itself with the 1.5 degree pathway established by the Paris Agreement in 2015. Part of these changes come in the form of a large spree of divestitures, which already started in 2017 and is expected to continue over the coming years (Raval, 2021). Rystad Energy expected oil majors to divest of a combined $100 billion in assets over the years following 2020 (Guldbrandsøy and Haarmann, 2020). However, more than half a decade after implementation of the Paris Agreement in November 2016, little to no research has been done to establish the value effects of environmental factors regarding divestitures in this industry. This study aims to unravel these effects by regressing divestiture announcement returns on a measure of company environmental commitments, created following an approach used by the EDF (2022), as well as two separate measures of actual environmental performance. First, the uses of the divestiture proceeds as mentioned in the corporate press release are categorized into green, neutral and brown uses. Second, an environmental performance score provided by the WBA (2021) is accessed. Lastly, two different greenwashing scores are constructed based on the difference between the level of environmental commitments and both performance scores, which are tested as well for a relation with announcement returns. Ultimately, this study attempts to answer the following research question:

What impact do companies' environmental commitments, performance and degree of greenwashing have on value creation through sell-offs by oil and gas companies following the Paris Agreement?

To answer this question, a dataset of 172 sell-offs – after deletion of those with significant other events taking place around the event date, along with several other reasons for exclusion – by global oil and gas companies is obtained from ThomsonOne. The transactions are filtered to include only divestitures of $150 million and over, by companies with a primary 2-digit SIC code of 13, 28 or 46. The size threshold is however lowered to $10 million for hypotheses 3 and 4 when including the performance score provided by the WBA, because this benchmark covers a smaller amount of divesting companies. According to Thomson Reuters (2023), this database offers "a complete picture of the deal-making landscape", and any potential omissions are considered to occur at random, as no information on a potential selection bias can be found. Three-day CARs are calculated using the CAPM model, benchmarking each individual security against its country or regional oil and gas index if available, or main country index otherwise. For robustness, CARs are subsequently re-estimated using a constant mean model. First, the overall presence of positive abnormal returns in the three days surrounding the divestitures is tested, leading to the first hypothesis: *Announcement returns on the divestiture announcement date are positive for sell-offs by oil and gas companies.* This hypothesis is confirmed, as the CARs are found to be 1.1 percent versus 1.0 percent as estimated with the CAPM and constant mean models, significantly different from zero at the five and ten percent significance level, respectively. These CARs are on the lower end of the range found in previous studies (being 1-2 percent as mentioned before), which could indicate that corporate governance in the sample is on average somewhat weaker, leading to lower value creation. This can for instance be due to potential forced divestitures. Although bankrupt companies have been excluded, further insight can be gained through including corporate governance metrics either as regressors or selection criteria.

Although no prior research is apparent on the value effects of divestitures with respect to environmental commitments such as climate targets, differing directions of a potential relation could be expected. Event studies on broader emissions reductions most recently painted a negative picture (Jacobs, 2014). Contrastingly, divestitures with a high degree of strategical relevance and internal consistency – arguably the case for divestitures following ambitious climate targets – have led to higher CARs (Montgomery et al., 1984; Brauer and Schimmer, 2010). Therefore, the second hypothesis was defined as: *Companies that have made a stronger commitment to reduce greenhouse gas emissions experience similar divestiture announcement returns to those that have not.* Initially, a negative relation between the constructed environmental commitment score and CARs is found to the extent of 3.6 percentage points lower CARs at the maximum versus minimum score. However, this result is not robust to inclusion of control variables. The robustness tests do not alter the findings, meaning that the hypothesis is confirmed and no relation is found.

Hypothesis 3 follows a similar trajectory, measuring actual performance rather than commitments: *Companies showing better actual environmental performance earn higher divestiture announcement returns than their peers.* After inclusion of all control variables, the only significant coefficients arise upon transforming the CARs to a binary variable. Both the green proceeds category as well as the emissions intensity of the divested asset are strongly negatively associated with the relative likelihood of obtaining positive CARs, thus pointing towards a negative effect. Stating to invest the proceeds in a 'green' labeled use, lowers these odds by 95 percent as compared to a neutral use (though no significant difference with brown intended uses arises). Similarly, an increase in the divested asset's emissions intensity by 1 kg per USD revenue (circa 1.46 standard deviation of the studied targets' emissions intensity) reduces these odds by 93 percent. However, this fixed effects specification caused almost half of the observations to drop due to collinearity, warranting caution regarding the reliability of these results. No significant relation is found in the second sample where performance is measured using the WBA benchmark score, meaning that generally, no relation prevails and only some slight evidence pointing to a negative effect is found. However, when regarding the disposal of highly emitting assets as 'bad' rather than 'good' environmental performance, the negative emissions intensity coefficient's interpretation turns around and does point towards a positive effect. The hypothesis is rejected, though more research regarding this potential relation would be of interest. An interesting additional finding here is that the residuals of a CAR regression on the top quartile by WBA performance score versus the bottom 75 percent, show nearly three times as much variation for the low scoring group, revealing lower risk levels surrounding divestitures by well-performing firms.

Due to a lack of prior research on the topic, no particular direction for a potential effect of greenwashing on CARs was hypothesized: *The extent to which companies engage in greenwashing (i.e., the differential between stated environmental commitments and actual performance) has no effect on divestiture announcement returns.* Both samples show similar results where no significant coefficient for either of the greenwashing scores is found across specifications. The fixed effects specifications do point toward a negative relation amounting to 1.1 to 2.2 percentage points lower CARs for a maximum versus minimum score, in line with Du's (2015) findings of value destruction at exposure of greenwashing. The insignificance however holds for the robustness tests, meaning that the fourth hypothesis is confirmed.

Subsequently, a positive effect of emissions intensity on assets moving towards private rather than public buyers is hypothesized: *More polluting oil and gas assets are more often divested to private companies compared to other oil and gas assets.* Although a positive coefficient persists across all specifications, also after deleting investor groups from the buying entities, no significance is achieved. Therefore, this hypothesis is rejected in favor of no effect. Lastly, potential arbitrage opportunities for divestitures moving towards an owner with lower environmental commitments (dubbed 'stewardship-at-risk' divestitures) are hypothesized: *'Stewardship-at-risk' divestitures earn greater announcement returns compared to other divestitures in the sample.* No effect is found across specifications, including the robustness tests. Therefore, the hypothesis is rejected. It is possible that existing arbitrage opportunities are countered by the finding that private companies have spent significantly less on the sampled divestitures, should this effect be persistent across all levels of deal values and not merely due to an absence of private buyers for extremely large divestitures.

Conclusively, environmental commitments, performance and the degree of greenwashing as measured in this study had little to no effect on the announcement returns of divestitures in the studied samples. Both environmental commitments and performance as proxied by the use of proceeds initially appear associated with lower returns, although not after the inclusion of the specified control variables. The only significant coefficients are found when regressing the binary variable for positive value creation on environmental performance as measured by a green labeled use of proceeds and the targets emissions intensity, both pointing to a negative effect of firm environmental performance on value creation. This is in line with a discount on highly emitting assets which fetch a lower disposal value, and an expected premium to be paid on green investments, leading to lower returns in case of green intended uses. In this case, buyers do value greenness and are willing to sacrifice financial returns for environmental performance. However, these results are not robust to other specifications and therefore require further research. The sample covered by the WBA shows no significant relations between any of the regressors and the CARs, leading to very low levels of R^2. This is possibly due to the included divestitures not being sufficiently large to influence divesting companies' share prices. Alternatively, the market simply might not differentiate on environmental factors in a consistent manner, possibly due to a lack of reliable information and comparability between firms.

Limitations to this study inevitably lie in the measurement of the environment related variables. Although this study follows quite sophisticated methodologies set out by the EDF, WBA and BofA Merrill Lynch, it remains difficult to quantify the actual level of commitment or performance. Additionally, the WBA benchmark is based on data reported only in 2019 and 2020, which is possibly not representative for other years and thus might attenuate any true effect. This applies as well to the emissions intensity averages estimated by BofA Merrill Lynch, which date from 2011.

With regard to the greenwashing scores, too little of a structural difference might exist between companies' environmental performance and their commitments as measured via the EDF methodology. Should the EDF have been successful in creating a methodology that – besides observing stated commitments – also rewards actual performance of the observed firms, the greenwashing scores based on the difference between these commitments and this study's measures of performance might be of limited value. The greenwashing coefficients likely capture some variation between companies' actual performance and their stated intentions, although it is unclear whether this is sufficient to reliably detect greenwashing.

Another limitation specific to the sample studied in combination with the WBA score, is the relative size of the divestitures to their parents' market capitalization. At only 2.3 percent of market capitalization on average, these have shown to exhibit little to no influence on the companies' share price as measured by the negative announcement returns. However, excluding smaller divestitures would have caused the sample size to be too small to reliably estimate the regression models.

A recommendation for future research would be to establish a greenwashing coefficient that more directly observes the promotion of environmentally friendly activities, which can subsequently be benchmarked against actual performance similar to in this study. De Freitas Netto et al. (2020) have researched the typical forms and characteristics of greenwashing in a meta-analysis of ten years of research on the topic, and found four major classifications of greenwashing. This can be seen as a matrix varying along firm versus product level greenwashing on one axis, against claim (i.e., making a misleading claim with regard to environmental performance) versus executional greenwashing (the use of nature evoking elements such as the color green or landscapes in an advertisements) on the other axis. Though product level greenwashing is potentially less prevalent across the oil and gas industry, a more representative greenwashing variable could be constructed by observing both claims made by oil and gas companies, as well as the level of executional greenwashing seen in advertisements.

Lastly, environmental reporting is increasingly gaining traction across industries due to initiatives including the Global Reporting Initiative (GRI), as well as the Greenhouse Gas Protocol specifically for carbon emissions. These initiatives provide standardized frameworks ensuring comparability in reporting between companies. Consequently, once reporting reaches a sufficient level of comparability, a more reliable and direct estimate of firm environmental performance can be studied, subsequently leading to better insight into its relation with value creation as measured by divestiture announcement returns. However, this still lies in the future according to the EDF (2022).

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APPENDIX A – Additional data description

Table 19

Overview of confounding events. This table provides an overview of the confounding events that led to the exclusion of certain divestitures from the studied sample. These events led to exclusion as they happened within 3 trading days before and 1 trading day after any divestiture.

Type of announcement	Number of instances
Earnings announcement or annual report	34
Earnings announcement and dividend change	5
Dividend change announcement	3
Concurring bid for parent company	3
Unrelated larger investment announced on prior trading day	2
Regulatory issues	2
Unrelated renewable investment or pledge	2
Change in growth forecast	2
Downsizing in employees announced	2
Reorganization announced	1
Equity issuance announced	1
Damage report publication	1
Announcement of legal challenges	1
Rumors on privatization and credit rating change	1
News release damaging reputation	1
Political victory influencing share price	1
Large oil discovery	1
Total	63

Table 20

Overview of the number of announced divestitures by each parent company.

Divesting parent company	# announcements	*continued*	
AltaGas Ltd	4	Magellan Midstream Partners LP	1
Anadarko Petroleum Corporation	2	Marathon Oil Corporation	2
Apache Corporation	2	Murphy Oil Corporation	1
Athabasca Oil Corporation	1	Neste Oyj	1
[1]BHP Billiton PLC	2	Noble Energy Inc	6
BP PLC	6	NuStar Energy LP	2
Cabot Oil & Gas Corporation	1	OMV AG	5
Callon Petroleum Co	2	Oasis Petroleum Inc	2
Calumet Specialty Products	1	Occidental Petroleum Corporation	4
Carrizo Oil and Gas Inc	2	Ovinitiv Inc	1
[1]Cenovus Energy Inc	8	PTT PCL	1
Chevron Corporation	6	Paramount Resources Ltd	1
Concho Resources Inc	2	Pengrowth Energy Corp	1
[1]ConocoPhillips	8	Petrofac Ltd	3
Crescent Point Energy Corporation	2	Petroleo Brasileiro SA	13
DONG Energy A/S	1	Pioneer Natural Resources Co	4
DANA Gas PJSC	1	Plains All American Pipeline	5
Delek Group Ltd	2	QEP Resources	1
Devon Energy Corporation	4	Qurain Petrochemical Inds	1
Diamondback Energy Inc	1	Reliance Industries	2
ENEOS Holdings Inc	3	Repsol SA	1
EQT Corporation	1	Riviera Resources Inc	1
Enbridge Inc	2	SM Energy Co	2
Encana Corp	3	Sapura Energy Berhad	1
Energean Oil and Gas Plc	1	Sasol Ltd	2
Equinor ASA	2	SemGroup Corp	1
Exxon Mobil Corporation	4	[1]Shell Plc	13
Gazprom PJSC	2	Sk Innovation Co Ltd	1
Genesis Energy LP	1	Southwestern Energy Co	1
Halcon Resources Corporation	2	Total SA	4
[1]Hess Corporation	3	Transneft PJSC	1
Husky Energy Inc	1	Tullow Oil PLC	1
Inter Pipeline Ltd	1	Unit Corporation	1
Kelt Exploration Ltd	1	WPX Energy Inc	1
Kosmos Energy Ltd	1	Woodside Petroleum Ltd	1
Maersk Drilling A/S	1		

[1]Includes two transactions within one day of another, which are combined for the analysis.

Table 21

Pairwise correlation matrix. This table presents a Pearson correlation matrix of pairwise correlations between the dependent and independent variables used in the main sample. The coefficients for the WBA sample and private acquirers have been omitted as these are based on other samples.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Number of obs.	172	172	172	172	172	172	154	154	154	154	172	172	172	172	172
(1) CAR	1.000														
(2) dealvalue	0.059	1.000													
(3) small	-0.265**	-0.042	1.000												
(4) medium	-0.003	0.060	-0.863**	1.000											
(5) large	0.527**	-0.027	-0.377**	-0.141	1.000										
(6) emissions	0.058	0.004	-0.137	0.161	-0.026	1.000									
(7) prc_green	-0.122	-0.063	0.075	-0.037	-0.079	-0.160	1.000								
(8) prc_neutral	-0.026	-0.058	-0.148	0.140	0.031	0.038	-0.312**	1.000							
(9) prc_brown	0.097	0.095	0.106	-0.120	0.015	0.054	-0.267**	-0.832**	1.000						
(10) grw_prc	-0.015	0.086	0.311**	-0.301**	-0.054	0.002	-0.303**	-0.597**	0.783**	1.000					
(11) mktcapb	-0.161	0.193	0.439**	-0.371**	-0.179	-0.063	0.088	-0.306**	0.259**	0.460**	1.000				
(12) ROA	-0.164	0.044	0.241**	-0.135	-0.224**	-0.036	0.133	0.038	-0.116	0.077	0.303**	1.000			
(13) DE	0.086	-0.060	-0.100	0.079	0.052	0.039	-0.044	-0.003	0.029	-0.033	-0.122	-0.404**	1.000		
(14) env_com	-0.145	0.018	0.374**	-0.331**	-0.128	-0.067	0.271**	-0.341**	0.188	0.682**	0.415**	0.237**	-0.086	1.000	
(15) SaR	-0.001	-0.088	0.046	0.035	-0.153	0.069	0.096	-0.283**	0.231**	0.319**	0.069	0.121	-0.058	0.353**	1.000

*** p<0.01, * p<0.05*

Table 22

Descriptive statistics for the WBA sample. This table presents the sample consisting of 147 divestiture announcements of ≥ $10m by oil and gas companies included in the WBA benchmark between 2017 and 2021. This includes all dependent, independent and control variables used regarding the WBA scores in hypothesis 3 and 4. The ThomsonOne data on acquirers and targets is matched with data from CRSP, Compustat, WBA, Yahoo Finance, Investing.com and corporate financial statements/press releases. Asset subindustries are based on a target's SIC code and the greenwashing score is computed as the difference between a parent's (normalized) environmental commitment score and the divestiture's (normalized) WBA performance score.

Variable	Obs	Mean	Median	St. dev	Min	Max
Divestiture Characteristics						
CAR (%) (-1, +1)	147	-0.514	-0.587	3.476	-8.552	16.694
Carbon intensity (kg / $ rev.)	147	0.648	0.814	0.572	0.017	3.961
Small (< 10%)	147	0.939	1.000	0.241	0.000	1.000
Medium (10% – 50%)	147	0.061	0.000	0.241	0.000	1.000
Large (≥ 50%)	147	0.000	0.000	0.000	0.000	1.000
Asset subindustry: upstream	147	0.660	1.000	0.476	0.000	1.000
Asset subindustry: midstream	147	0.041	0.000	0.199	0.000	1.000
Asset subindustry: downstream	147	0.150	0.000	0.358	0.000	1.000
Asset subindustry: other	147	0.150	0.000	0.358	0.000	1.000
Greenwashing score WBA	147	0.568	0.553	0.144	0.390	0.915
Target Parent Characteristics						
ROA	147	0.007	0.017	0.050	-0.259	0.116
Debt-to-equity	147	0.638	0.540	0.366	0.107	1.959
Region: Western	147	0.707	1.000	0.456	0.000	1.000
Region: Arabic	147	0.293	0.000	0.456	0.000	1.000
Region: Emerging	147	0.000	0.000	0.000	0.000	0.000
Environmental commitment score	147	1.204	0.000	1.266	0.000	4.000
WBA performance score	147	3.290	3.300	1.370	1.000	8.100

Table 23

Descriptive statistics for the public-to-private sample. This table presents the sample consisting of 241 oil and gas divestiture announcements of ≥ $150m between 2017 and 2021, including all dependent, independent and control variables used in this subsample. The ThomsonOne data on acquirers and targets is matched with data from Compustat. Asset subindustries are based on a target's SIC code.

Variable	Obs	Mean	Median	St. dev	Min	Max
Private acquirer	241	0.552	1.000	0.498	0.000	1.000
ROA	241	-0.008	0.011	0.067	-0.267	0.175
Deal value ($bn)	241	1.110	0.500	2.089	0.150	21.000
Carbon intensity (kg / $ rev.)	241	0.663	0.814	0.568	0.005	3.961
Asset subindustry: upstream	241	0.676	1.000	0.469	0.000	1.000
Asset subindustry: midstream	241	0.104	0.000	0.306	0.000	1.000
Asset subindustry: downstream	241	0.133	0.000	0.340	0.000	1.000
Asset subindustry: other	241	0.087	0.000	0.283	0.000	1.000
Region: Western	241	0.863	1.000	0.344	0.000	1.000
Region: Arabic	241	0.021	0.000	0.143	0.000	1.000
Region: Emerging	241	0.116	0.000	0.321	0.000	1.000

Table 24

SIC classifications in the extended sample. This table presents the number of announced deals per SIC classification and acquirer ownership type in the extended sample. This reincludes divestitures of a private parent, with confounding events and simultaneous divestitures as only the type of buyer is of interest.

2-digit SIC classification	Target	Parent	Acquirer	Parent
12: Bituminous Coal and Lignite Mining	-	-	-	1
13: Oil and Gas Extraction	165	165	119	96
14: Nonmetallic Minerals, Except Fuels	1	-	-	-
16: Heavy Construction except Building	-	-	-	1
17: Construction Special Trade Contractors	-	-	2	2
20: Food and Kindred Products	-	-	-	1
23: Apparel and Other Textile Products	-	-	-	1
28: Chemical & Allied Products	6	-	8	7
29: Petroleum & Coal Products	15	57	8	20
36: Electrical and Electronic Equipment	-	-	-	1
38: Instruments and Related Products	-	-	1	1
42: Trucking & Warehousing	2	-	1	1
44: Water Transportation	-	-	1	1
46: Pipelines, Except Natural Gas	9	19	9	5
49: Electric, Gas, & Sanitary Services	21	-	20	13
50/51: Wholesale Trade – (Non)Durable Goods	9	-	8	6
53: General Merchandise Stores	-	-	1	1
54: Food Stores	-	-	2	2
55: Automotive Dealers & Service Stations	6	-	3	2
59: Miscellaneous Retail	2	-	-	-
60: Depository Institutions	-	-	-	3
63: Insurance Carriers	-	-	1	6
64: Insurance Agents, Brokers & Service	-	-	1	-
65: Real Estate	4	-	1	1
67: Holding & Other Investment Offices	1	-	54[1]	68[1]
73: Business Services	-	-	1	1
Publicly owned	n/a	241	n/a	108
Privately owned	n/a	-	n/a	133
Total	241	241	241	241

[1]Includes 10 investor groups of companies in other sectors as per ThomsonOne definition.

Table 25

Benchmark indices per exchange of the divesting companies' primary listing. Benchmarks are selected as the respective country or region's Oil and Gas or Energy index if available. In the cases of BP, Lundin Energy, Shell and Total, a domestic Oil and Gas index was available, but replaced with the total country index due to extreme correlation with the divesting company. E.g., the AEX Oil and Gas index consists of 3 constituents among which Shell, leading to a beta of 1 and R^2 of 0.999 with Shell's share price.

Country/Region	Primary Exchange	Benchmark Index	Number of Companies
U.S.	NYSE	Dow Jones US Oil and Gas Index	37
Canada	TSX	TSX EW Oil and Gas Index	11
U.K.	LSE	FTSE 100/FTSE Oil and Gas Index	5
Nordics	OMX	OMX Oil and Gas Index/OMX Stockholm 30	4
Russia	MOEX	MOEX Oil and Gas Index	2
Abu Dhabi	ADX	FTSE ADX General	1
Austria	ATX	ATX Index	1
Brazil	Bovespa	Bovespa Index	1
France	Euronext Paris	CAC 40	1
India	BSE	BSE Oil and Gas Index	1
Israel	TASE	TA Oil and Gas Index	1
Japan	Nikkei	Nikkei 225	1
Korea	KRX	KRX Energy & Chemical Index	1
Kuwait	Boursa Kuwait	Premier Market - Market Cap Weighted PR	1
Malaysia	Bursa Malaysia	FTSE Bursa Malaysia KLSE	1
Netherlands	Euronext Ams.	AEX Index	1
South Africa	JSE	South Africa Top 40	1
Spain	IBEX	IBEX 35	1
Thailand	SET	FTSE SET All-Share	1
Total			73[1]

[1]One observation more than the number of companies due to Encana transferring corporate domicile from Canada to the U.S., under the new name Ovinitiv.

Table 26

SIC 4-digit carbon intensity levels. This table presents an overview of the carbon intensity levels as measured by BofA Merrill Lynch (2013), in grams of CO_2 / $ in revenue. The data is measured through company reporting in 2011 and fitted to the 4-digit SIC codes through Inverse Distance Weighted Interpolation (IDWI).

SIC code	Number of targets	Direct emissions	Indirect emissions	Total emissions
1311	144	790.1	24.0	814.1
1321	8	423.1	40.7	463.8
1381	3	56.8	17.4	74.2
1382	9	335.0	7.4	342.4
1389	1	40.5	3.3	43.8
1422	1	355.9	327.1	683.0
2819	1	245.4	19.8	265.2
2821	0[1]	257.1	132.7	389.8
2822	1	257.1	132.7	389.8
2836	1	8.2	18.6	26.8
2865	3	852.7	47.8	900.5
2869	0[1]	213.7	96.0	309.7
2873	0[1]	469.0	130.7	599.7
2911	14	239.4	25.5	264.9
2999	1	251.7	41.8	293.5
3674	0[1]	16.8	36.2	53.0
4213	0[1]	6.5	17.0	23.5
4221	1	8.8	4.0	12.8
4225	1	1.1	4.0	5.1
4612	7	74.8	140.5	215.3
4613	1	74.8	140.5	215.3
4619	1	74.8	140.5	215.3
4812	0[1]	0.9	22.9	23.8
4911	5	3,927.3	33.6	3,960.9
4922	10	74.8	21.6	96.4
4923	2	772.7	15.9	788.6
4924	2	307.1	12.8	319.9
4941	1	188.6	138.2	326.8
499A	1	307.1	12.8	319.9
5171	6	115.4	43.3	158.7
5172	3	39.9	25.3	65.2
5411	0[1]	17.7	32.1	49.8
5541	6	17.7	32.1	49.8
5989	2	9.4	7.4	16.8
6512	4	7.2	78.6	85.8
6799	1	1.2	3.8	5.0
7011	0[1]	22.7	155.7	178.4
8711	0[1]	15.6	7.5	23.1
Total	241	n.a.	n.a.	n.a.

[1]These SIC codes are reported since they have been divested in the WBA sample (< $150m).

Table 27

List of private acquirers. This table presents an overview of all private acquirers and their number of acquisitions in the sample. It specifies whether they are large state owned entities as a proxy for their extended ability to buy large assets.

Acquiror Ultimate Parent	Number of acquisitions	State owned major
Undisclosed	13	–
Investor Group	5	–
Brookfield Asset Management Inc	4	–
INEOS Group AG	3	–
EIG Global Energy Partners LLC	2	–
Hilcorp Energy Co	2	–
Investore AS	2	–
Perenco (Oil & Gas) International Ltd	2	–
Perenco SA	2	–
Quantum Energy Partners LLC	2	–
Apollo Global Management LLC	1	–
ArcLight Capital Partners LLC	1	–
Atem’s Distribuidora	1	–
Avenue Capital Group LLC	1	–
Bank VTB PAO	1	–
Banpu PLC	1	–
CLH Group Ltd	1	–
CPPIB	1	–
CSV Midstream Solutions Corp	1	–
Caerus Oil & Gas LLC	1	–
China Petrochemical Corp (Sinopec)	1	Yes
Colgate Energy Partners III	1	–
DJR Energy LLC	1	–
EG Group Ltd	1	–
Enduring Resources IV LLC	1	–
Federated Co-operatives Ltd	1	–
Flywheel Energy Operating LLC	1	–
Fundare Resources Co LLC	1	–
Grupo Copetrol	1	Yes
Havila Holding AS	1	–
Hibiscus Petroleum Bhd	1	–
INEOS Capital Ltd	1	–

Table 27 – Continued

Acquiror Ultimate Parent	Number of acquisitions	State owned major
Industry Super Holdings Pty	1	–
Ipr Energy Grp	1	–
KKR & Co Inc	1	–
Karavan Oil & Gas	1	–
Lime Rock Management LP	1	–
MB Holding Co LLC	1	–
Mubadala Investment Co PJSC	1	Yes, non-oil
NGP Energy Capital Mgmt LLC	1	–
Neptune Energy Grp Hldg Ltd	1	–
Nippon Life Insurance Co	1	–
OPSEU Pension Plan Trust Fund	1	–
Off The Shelf Invests Fifty	1	–
Percussion Petroleum LLC	1	–
Petroleos Mexicanos SA	1	Yes
Petroliam Nasional Bhd	1	Yes
Pinedale Energy Partners LLC	1	–
Riverstone Holdings LLC	1	–
Saudi Arabian Oil Co	1	Yes
Sequitur Energy Resources LLC	1	–
Silver Creek Midstream LLC	1	–
Six One Commodities LLC	1	–
Sk Inc	1	–
Spur Energy Partners Llc	1	–
Steel Reef Infrastructure Corp	1	–
Suek Ltd	1	–
The Carlyle Group Inc	1	–
The Carlyle Group LP	1	–
The Howard Hughes Corp	1	–
Trident Energy Management Ltd	1	–
United Energy Group Ltd	1	–
Validus Energy	1	–
Venado Oil & Gas LLC	1	–

Table 27 – Continued

Acquiror Ultimate Parent	Number of acquisitions	State owned major
Vitol Holding BV	1	–
Wamsutter E&P LLC	1	–
Waterous Energy Fund LP	1	–
Yehiel Abu	1	–
Total	95	6[1]

[1]Total number of acquisitions by large, state-owned (oil) companies.

Table 28

Additional descriptive statistics for robustness tests. This table presents the sample consisting of 172 oil and gas divestiture announcements of ≥ $150m between 2017 and 2021, including the additional dependent, independent and control variables used. The ThomsonOne data on acquirers and targets is matched with data from Compustat and CRSP. Statistics for the winsorized variables are reported in Table 32.

Variable	Obs	Mean	Median	St. dev	Min	Max
Main sample						
pos_CAR	172	0.506	1.000	0.501	0.000	1.000
mean_CAR	172	0.010	0.001	0.075	-0.228	0.536
WBA sample						
pos_CAR	147	0.429	0.000	0.497	0.000	1.000
mean_CAR	147	-0.006	-0.005	0.043	-0.228	0.203
high_WBA	147	0.204	0.204	0.404	0.000	1.000

APPENDIX B – Model specifications

General remarks on notation

CAR_i is the CAR for observation *i* and signifies a (pooled) OLS specification.

CAR_{jt} is the CAR for firm *j* at time *t*, used in combination with α_j as a specific intercept for each firm *j* and thus specifying firm fixed effects.

In addition to firm fixed effects, Y2-Y5 represent year dummies for 2018-2021, thus meaning year fixed effects are included.

Specifications general results

Hypothesis 1

$$CAR_i = \alpha + \varepsilon_i \quad (5)$$

Hypothesis 2

$$CAR_i = \alpha + \beta_1 env\_com_i + \varepsilon_i \quad (6)$$

$$CAR_i = \alpha + \beta_1 env\_com_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \beta_6 large_i + \varepsilon_i \quad (7)$$

$$CAR_{jt} = \alpha_j + \beta_1 env\_com_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \varepsilon_{jt} \quad (8)$$

$$CAR_{jt} = \alpha_j + \beta_1 env\_com_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (9)$$

Hypothesis 3

$$CAR_i = \alpha + \beta_1 prc\_green_i + \beta_2 prc\_neutral_i + \varepsilon_i \quad (10)$$

$$CAR_i = \alpha + \beta_1 prc\_green_i + \beta_2 prc\_neutral_i + \beta_3 emissions_i + \varepsilon_i \quad (11)$$

$$CAR_i = \alpha + \beta_1 prc\_green_i + \beta_2 prc\_neutral_i + \beta_3 emissions_i + \beta_4 ROA_i + \beta_5 DE_i + \beta_6 medium_i + \beta_7 large_i + \varepsilon_i \quad (12)$$

$$CAR_{jt} = \alpha_j + \beta_1 prc\_green_{jt} + \beta_2 prc\_neutral_{jt} + \beta_3 emissions_{jt} + \beta_4 ROA_{jt} + \beta_5 DE_{jt} + \beta_6 medium_{jt} + \beta_7 large_{jt} + \varepsilon_{jt} \quad (13)$$

$$CAR_i = \alpha + \beta_1 perf\_WBA_i + \varepsilon_i \quad (14)$$

$$CAR_i = \alpha + \beta_1 perf\_WBA_i + \beta_2 emissions_i + \varepsilon_i \quad (15)$$

$$CAR_i = \alpha + \beta_1 perf\_WBA_i + \beta_2 emissions_i + \beta_3 ROA_i + \beta_4 DE_i + \beta_5 medium_i + \varepsilon_i \quad (16)$$

Hypothesis 4

$$CAR_i = \alpha + \beta_1 grw\_prc_i + \varepsilon_i \quad (17)$$

$$CAR_i = \alpha + \beta_1 grw\_prc_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \beta_6 large_i + \varepsilon_i \quad (18)$$

$$CAR_{jt} = \alpha_j + \beta_1 grw\_prc_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \varepsilon_{jt} \quad (19)$$

$$CAR_{jt} = \alpha_j + \beta_1 grw\_prc_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (20)$$

$$CAR_i = \alpha + \beta_1 grw\_WBA_i + \varepsilon_i \quad (21)$$

$$CAR_i = \alpha + \beta_1 grw\_WBA_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \varepsilon_i \quad (22)$$

$$CAR_i = \alpha + \beta_1 grw\_WBA_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \gamma_1 Y2_i + \gamma_2 Y3_i + \gamma_3 Y4_i + \gamma_4 Y5_i + \varepsilon_i \quad (23)$$

Hypothesis 5

$$Private\_acq_i = \alpha + \beta_1 emissions_i + \varepsilon_i \quad (24)$$

$$Private\_acq_i = \alpha + \beta_1 emissions_i + \beta_2 ROA_i + \beta_3 dealvalue_i + \varepsilon_i \quad (25)$$

$$Private\_acq_i = \alpha + \beta_1 emissions_i + \beta_2 ROA_i + \beta_3 dealvalue_i + \gamma_1 Y2_i + \gamma_2 Y3_i + \gamma_3 Y4_i + \gamma_4 Y5_i + \varepsilon_i \quad (26)$$

$$Private\_acq_i = \alpha + \beta_1 emissions_i + \beta_2 ROA_i + \beta_3 dealvalue_i + \gamma_1 Y2_i + \gamma_2 Y3_i + \gamma_3 Y4_i + \gamma_4 Y5_i + \gamma_5 S2_i + \gamma_6 S3_i + \gamma_7 S4_i + \varepsilon_i \quad (27)$$

Where S2-S4 represent additional dummy variables for subindustries ‘upstream’, ‘midstream’ and ‘downstream’ (with reference category ‘other’).

Hypothesis 6

$$CAR_i = \alpha + \beta_1 SaR_i + \varepsilon_i \quad (28)$$

$$CAR_i = \alpha + \beta_1 SaR_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 medium_i + \beta_5 large_i + \varepsilon_i \quad (29)$$

$$CAR_{jt} = \alpha_j + \beta_1 SaR_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 medium_{jt} + \beta_5 large_{jt} + \varepsilon_{jt} \quad (30)$$

Specifications robustness tests

Subsequent model specifications are reported by table rather than hypothesis in order to maintain chronological sequencing, given that some results are reported in the appendix.

Table 13

$$pos\_CAR_{jt} = \alpha_j + \beta_1 env\_com_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (32)$$

$$mean\_CAR_{jt} = \alpha_j + \beta_1 env\_com_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (33)$$

$$CAR_{jt} = \alpha_j + \beta_1 env\_com_{jt} + \beta_2 ROA\_w_{jt} + \beta_3 DE\_w_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (34)$$

Table 14

$$pos\_CAR_{jt} = \alpha_j + \beta_1 prc\_green_{jt} + \beta_2 prc\_brown_{jt} + \beta_3 emissions_{jt} + \beta_4 ROA_{jt} + \beta_5 DE_{jt} + \beta_6 medium_{jt} + \beta_7 large_{jt} + \varepsilon_{jt} \quad (35)$$

$$pos\_CAR_i = \alpha + \beta_1 prc\_green_i + \beta_2 prc\_brown_i + \beta_3 emissions_i + \beta_4 ROA_i + \beta_5 DE_i + \beta_6 medium_i + \beta_7 large_i + \varepsilon_i \quad (36)$$

$$mean\_CAR_{jt} = \alpha_j + \beta_1 prc\_green_{jt} + \beta_2 prc\_neutral_{jt} + \beta_3 emissions_{jt} + \beta_4 ROA_{jt} + \beta_5 DE_{jt} + \beta_6 medium_{jt} + \beta_7 large_{jt} + \varepsilon_{jt} \quad (37)$$

$$CAR_{jt} = \alpha_j + \beta_1 prc\_green_{jt} + \beta_2 prc\_neutral_{jt} + \beta_3 emissions_{jt} + \beta_4 ROA\_w_{jt} + \beta_5 DE\_w_{jt} + \beta_6 medium_{jt} + \beta_7 large_{jt} + \varepsilon_{jt} \quad (38)$$

Table 15

$$pos\_CAR_{jt} = \alpha_j + \beta_1 grw\_prc_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (39)$$

$$mean\_CAR_{jt} = \alpha_j + \beta_1 grw\_prc_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (40)$$

$$CAR_{jt} = \alpha_j + \beta_1 grw\_prc_{jt} + \beta_2 ROA\_w_{jt} + \beta_3 DE\_w_{jt} + \beta_4 ln(mktcapb)_{jt} + \beta_5 medium_{jt} + \beta_6 large_{jt} + \gamma_1 Y2_{jt} + \gamma_2 Y3_{jt} + \gamma_3 Y4_{jt} + \gamma_4 Y5_{jt} + \varepsilon_{jt} \quad (41)$$

Table 16

$$pos\_CAR_{jt} = \alpha_j + \beta_1 SaR_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 medium_{jt} + \beta_5 large_{jt} + \varepsilon_{jt} \quad (42)$$

$$mean\_CAR_{jt} = \alpha_j + \beta_1 SaR_{jt} + \beta_2 ROA_{jt} + \beta_3 DE_{jt} + \beta_4 medium_{jt} + \beta_5 large_{jt} + \varepsilon_{jt} \quad (43)$$

$$CAR_{jt} = \alpha_j + \beta_1 SaR_{jt} + \beta_2 ROA\_w_{jt} + \beta_3 DE\_w_{jt} + \beta_4 medium_{jt} + \beta_5 large_{jt} + \varepsilon_{jt} \quad (44)$$

Table 17

$$CAR_i = \alpha + \beta_1 high\_WBA_i + \varepsilon_i \quad (45)$$

$$CAR_i = \alpha + \beta_1 high\_WBA_i + \beta_2 emissions_i + \varepsilon_i \quad (46)$$

$$CAR_i = \alpha + \beta_1 high\_WBA_i + \beta_2 emissions_i + \beta_3 ROA_i + \beta_4 DE_i + \beta_5 medium_i + \varepsilon_i \quad (47)$$

Table 33

$$mean\_CAR_i = \alpha + \varepsilon_i \quad (48)$$

Table 34

$$pos\_CAR_i = \alpha + \beta_1 perf\_WBA_i + \beta_2 emissions_i + \beta_3 ROA_i + \beta_4 DE_i + \beta_5 medium_i + \varepsilon_i \quad (49)$$

$$mean\_CAR_i = \alpha + \beta_1 perf\_WBA_i + \beta_2 emissions_i + \beta_3 ROA_i + \beta_4 DE_i + \beta_5 medium_i + \varepsilon_i \quad (50)$$

$$CAR_i = \alpha + \beta_1 perf\_WBA_i + \beta_2 emissions_i + \beta_3 ROA\_w_i + \beta_4 DE\_w_i + \beta_5 medium_i + \varepsilon_i \quad (51)$$

$$pos\_CAR_i = \alpha + \beta_1 grw\_WBA_i + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \gamma_1 Y2_i + \gamma_2 Y3_i + \gamma_3 Y4_i + \gamma_4 Y5_i + \varepsilon_i \quad (52)$$

$$mean\_CAR_i = \alpha + \beta_1 grw_{WBA_i} + \beta_2 ROA_i + \beta_3 DE_i + \beta_4 \ln(mktcapb)_i + \beta_5 medium_i + + \gamma_1 Y2_i + \gamma_2 Y3_i + \gamma_3 Y4_i + \gamma_4 Y5_i + \varepsilon_i \quad (53)$$

$$CAR_i = \alpha + \beta_1 grw\_WBA_i + \beta_2 ROA\_w_i + \beta_3 DE\_w_i + \beta_4 ln(mktcapb)_i + \beta_5 medium_i + \gamma_1 Y2_i + \gamma_2 Y3_i + \gamma_3 Y4_i + \gamma_4 Y5_i + \varepsilon_i \quad (54)$$

APPENDIX C – Additional results

Table 29

Logit versus probit information criteria of private acquirer regression. This table presents the AIC and BIC information criteria for distinguishing between a logit or probit model specification. Both regressions are run with normal standard errors. The full model specification is reported in section 4.6

Model specification	N	AIC	BIC
Logit of specification (25)	241	332.689	346.625
Probit of specification (25)	241	332.636	346.575

Table 30

Heteroskedasticity tests. This table presents all tests for heteroskedasticity of the error terms in the pooled OLS specifications and fixed effects specifications. These are used to determine the type of standard errors used in the random effects and fixed effects models, respectively. Robust (clustered) standard errors are included if $p < 0.05$. hypothesis 5 is omitted as heteroskedasticity is not similarly tested with logit specifications.

Panel A: Pooled OLS specifications

Hypothesis	BP χ^2 statistic	P-value	Type SEs
H2	347.65	0.00	Robust
H3 – proceeds	307.79	0.00	Robust
H3 – WBA	2.24	0.13	Normal
H4 – proceeds	294.24	0.00	Robust
H4 – WBA	17.11	0.00	Robust
H6	312.92	0.00	Robust

Panel B: Fixed effects specifications

Hypothesis	Dimension	Wald χ^2 statistic	P-value	Type SEs
H2	Year	94.97	0.00	Robust
	Firm	1.3e+34	0.00	Robust
	Subindustry	47.03	0.00	Robust
H3 – proceeds	Year	52.68	0.00	Robust
	Firm	3.8e+33	0.00	Robust
	Subindustry	51.64	0.00	Robust
H3 – WBA	Year	13.09	0.02	Robust
	Region	4.96	0.08	Normal
	Subindustry	17.65	0.00	Robust
H4 – proceeds	Year	68.07	0.00	Robust
	Firm	2.9e+34	0.00	Robust
	Subindustry	49.07	0.00	Robust
H4 – WBA	Year	12.29	0.03	Robust
	Region	5.66	0.06	Normal
	Subindustry	12.52	0.01	Robust
H6	Year	65.38	0.00	Robust
	Firm	4.2e+33	0.00	Robust
	Subindustry	31.75	0.00	Robust

Table 31

Likelihood-ratio tests of logit panel variation. This table presents the likelihood-ratio tests for panel-level variance ($\rho = 0$) in random effects specifications along four potential panel variables: firm, year, subindustry and region. Normal standard errors are included in the random effects specifications. Significant variation is found if p < 0.05.

Panel variable	$\bar{\chi}^2$ statistic	P-value
Year	0.00	1.00
Firm	0.94	0.17
Subindustry	0.00	1.00
Region	0.00	1.00

Table 32

Descriptive statistics of ROA and DE after winsorizing. This table presents the descriptive statistics for 'ROA' and 'DE' after winsorizing at 1, 2.5 and 5 percent levels on both ends of the distribution. 'Debt-to-equity' is only winsorized at the upper bound given its prior boundary of zero.

Variable	Obs	Mean	Median	St. dev	Min	Max
No winsorizing						
ROA	172	-0.012	0.010	0.071	-0.267	0.157
Debt-to-equity	172	1.565	0.627	6.079	0.019	56.502
Winsorizing at 1%						
ROA	172	-0.012	0.010	0.071	-0.262	0.151
Debt-to-equity	172	1.565	0.627	6.079	0.019	56.502
Winsorizing at 2.5%						
ROA	172	-0.013	0.010	0.067	-0.252	0.076
Debt-to-equity	172	0.938	0.627	1.018	0.019	5.698
Winsorizing at 5%						
ROA	172	-0.011	0.010	0.057	-0.177	0.055
Debt-to-equity	172	0.813	0.627	0.550	0.019	2.221

Table 33

Significance of mean estimated CAR. This table presents the results of the average 'mean_CAR' across the studied sample. 'mean_CAR' is measured over the period [-1, 1] days surrounding the event date and is benchmarked against the 120-day estimation window average return. The figure between parentheses presents the standard error.

	mean_CAR (48)	95% conf. interval
_cons	0.010** (0.006)	-0.001 – 0.021
Obs	172	
Root MSE	0.075	

** p<0.1*

Table 34

Robustness results WBA. This table presents the results of the robustness tests on the CAR regressions on WBA performance and greenwashing scores, along with several control variables. CARs are measured over the period [-1, 1] days surrounding the event date. Models (49) and (52) are logit regressions on positive value creation 'pos_CAR', the other models are OLS regressions on CARs using the constant mean method 'mean_CAR', and the prior 'CAR'. 'perf_WBA' and 'grw_WBA' represent the performance by WBA and the greenwashing scores based on it, whereas 'emissions' represents the carbon intensity in kg CO_2/USD revenue. 'ROA' is the average ROA over the 3 years preceding the divestiture and 'DE' is the debt-to-equity ratio using book values of the preceding fiscal year-end (suffix _w signifies the winsorized variable). 'mktcapb' presents the market capitalization in USD billions. 'medium' is a dummy for the relative size of the divestitures to their parent's market capitalization against reference category 'small' ('large' is omitted since no divestitures in this sample meet this size threshold). The figures between parentheses present robust standard errors for (53) and (54) and normal standard errors otherwise. The pseudo R^2 is reported for the logit models, the within R^2 for the fixed effects regressions (53) and (54).

Panel A: Performance based on WBA performance score			
	CAR (49)	CAR (50)	CAR (51)
perf_WBA	0.088	0.001	-0.001
	(0.126)	(0.003)	(0.002)
emissions	0.243	0.000	0.000
	(0.306)	(0.006)	(0.005)
ROA	2.704	0.090	
	(3.983)	(0.082)	
ROA_w			0.129
			(0.101)
DE	0.379	0.011	
	(0.514)	(0.011)	
DE_w			0.008
			(0.010)
medium	-0.305	0.008	
	(0.744)	(0.015)	
_cons	-0.982*	-0.016	-0.011
	(0.580)	(0.012)	(0.010)
Firm fixed effects	No	No	No
Obs	147	147	147
R^2	0.013	0.014	0.017
Pseudo R^2	n.a.	-0.022	-0.018

Panel B: Greenwashing score based on WBA performance score			
	pos_CAR (52)	mean_CAR (53)	CAR (54)
grw_WBA	1.672	0.025	0.021
	(1.786)	(0.027)	(0.027)
ROA	3.747	0.128	
	(4.488)	(0.090)	
ROA_w	0.421	0.009	0.197
	(0.578)	(0.010)	(0.124)
DE	-0.248	-0.006	
	(0.212)	(0.005)	
DE_w	-0.532	0.006	0.011
	(0.798)	(0.024)	(0.010)
ln(mktcapb)	1.672	0.025	-0.006
	(1.786)	(0.027)	(0.005)

Table 34 - Continued			
medium	3.747	0.128	0.006
	(4.488)	(0.090)	(0.023)
_cons	-0.372	0.005	0.005
	(1.009)	(0.024)	(0.024)
Firm fixed effects	No	No	No
Year fixed effects	Yes	Yes	Yes
Obs	147	147	147
R^2	0.023	0.042	0.041
Adj. R^2	n.a.	-0.021	-0.022

*** *p<0.01*, ** *p<0.05*, * *p<0.10*

Table 35

Overview of squared residuals of model (42) grouped by 'high_WBA'. The difference in means is significant following a Breusch-Pagan heteroskedasticity test on a regression of the residuals on 'high_WBA' at the 1 percent level (χ^2 = 6.88).

Squared residual of model (42)	Obs	Mean
Top quartile of WBA performance	117	0.0013
Bottom 75 percent of WBA performance	30	0.0005