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# Sell-offs in the U.S. Oil and Gas Industry and Parent Company Shareholder Wealth

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# PREFACE AND ACKNOWLEDGEMENTS

This paper concludes my master studies in Financial Economics. During the program I chose to enrol in the courses of the Corporate Finance track. Therefore, I am grateful for the opportunity to write this thesis on a corporate finance subject and to apply my knowledge. First of all, I would like to thank my supervisor, Dr. Jan Lemmen, for his constructive feedback and encouraging comments during the entire writing process. Furthermore, I would like to thank my twin sister, Darlinne Carmelia, and my parents, Dorien van den Boom and Maynard Carmelia, for their unconditional support. Finally, I am grateful for my closest friends, who have always believed in me.

## ABSTRACT

Recently, investors have been attacked by fossil fuel divestment campaigns to get rid of their stakes in oil and gas firms with polluting business activities, as the oil and gas reserves of these firms are the main drivers of global warming. Besides that, oil and gas companies themselves are starting to recognize the effect of the reserves on their firm value. Therefore, this paper studies the extent to which sell-offs in the fossil fuel industry create value for parental firms' shareholders. By means of an event study, stock market reactions to 300 voluntary U.S. divestment announcements over the time period 2004-2021 are evaluated. Moreover, multiple linear regressions capture the effect of the 2015 Paris Agreement, oil price and proved oil and gas reserves on the abnormal returns. The results indicate a positive stock market reaction to sell-off announcements of fossil fuel companies. The paper concludes that abnormal returns are higher for companies with higher levels of fossil fuel reserves.



**Keywords:** divestiture, event study, United States, fossil fuel reserves

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# CHAPTER 1 Introduction

Each year U.S. companies undertake numerous divestments. Specifically, managers may choose to spin off or sell off a certain asset of their business. In a spin-off the parent firm sells an asset, such as a division, unit or subsidiary, for stock to the existing parental firm's shareholders (Prezas & Simonyan, 2015). As a result, the asset becomes a separately traded independent firm. In contrast, in a sell-off the parent firm sells a certain asset for cash or stock to another entity, which is the acquirer in the divestiture transaction. Furthermore, a parent company can conduct an equity carve-out. In that case, there is an initial public offering, in which the parent company sells its subsidiary for shares.

However, why would managers voluntary give up their entire ownership of certain assets? Prior literature proposes three main hypotheses to answer this question (Chen & Guo, 2005). First, the information hypothesis states that divestitures can be used to reduce information asymmetry between the capital market and the parent firm, which in turn alleviates undervaluation. Second, divestitures are a mechanism to raise capital, since parent firms are often capital constrained, as proposed by the financing hypothesis. Third, the focusing hypothesis states that divestitures enable managers to refocus their businesses. In line with this hypothesis, the investment efficiency of remaining divisions of the parent firm could improve after the divestiture, which is associated with a significant reduction in the diversification discount (Dittmar & Shivdasani, 2003). It follows that, to a certain extent, inefficient divisional policies are attributing to the discount at which a diversified parent company is trading before the divestiture. A commonly used measure of investment efficiency is the asset turnover ratio, i.e., the ratio of net revenue or sales to average assets. Asset turnover indicates the ability of the company to generate revenues from its assets (Fairfield & Yohn, 2001). Hence, corporate focus could lead to better use of assets, in which case the asset turnover ratio, i.e., investment efficiency, increases after the divestment. Given these hypotheses, the majority of prior studies find positive shareholder wealth effects arising from the public divestment announcements (Kang & Diltz, 2000).

An industry in which divestments are relatively common, is the oil and gas industry. The large fossil fuel reserves in the industry are prone to value reduction, which is why these reserves are also known as "stranded assets". An important reason for this is that, besides the ultimate depletion of oil and gas reserves, the use of oil and gas is the main driver of global warming (United Nations, 2021). Therefore, fossil fuel corporations have been 'attacked' by divestment campaigns of climate activists as of 2011. In contrast to divestment decisions of oil & gas producers themselves, these campaigns are aimed at investors and institutions to divest their stakes in fossil fuel companies, which has become a trending topic in the empirical literature. In particular, recent literature considers portfolio theory to examine the investor implications of fossil fuel divestments. The results seem to confirm that divestments of stakes in fossil fuel companies and inclusion of clean energy producers could enhance portfolio performance for investors (Henriques & Sadorsky, 2018). Furthermore, recently, the coronavirus pandemic lead to a collapse in oil demand and prices (Atanasova & Schwartz, 2019). Since the start of the pandemic, oil and gas companies have been offering more assets up for sale in order to improve their cash flows and competitive position (Nair, 2020). Hence, the oil and gas industry is under pressure to transition to cleaner energy.

Although the investor portfolio implications of fossil fuel divestments are emphasized in the literature, there is a lack of studies on sell-off decisions by fossil fuel companies themselves. Therefore, I derive the following research question:

> *To what extent do sell-offs in the fossil fuel industry create value for the parental firms' shareholders?*

The answer to this question is scientifically relevant, as there is still an ongoing debate in the literature with regard to the effect of divestitures on shareholder wealth, as measured by the abnormal returns around the announcement date. For instance, there could be positive cumulative average returns before the announcement date, but not after (Hearth & Zaima, 1984). This would indicate that there is no effect of the divestment on the firm's financial performance. Moreover, measurement errors could also produce positive effects (Colak & Whited, 2007). Hence, it is not straightforward whether divestments positively affect shareholder wealth, in particular for the parent firm. Moreover, the literature seems to lack recent event studies on divestment announcement effects.

Lastly, research into divestitures in the oil and gas industry is societally relevant. To this day, the U.S. has the largest share in the world oil production and consumption (EIA, 2021). In 2015, world governments already agreed upon a limit of 1.5 degrees Celsius temperature increase in order to reduce global warming (United Nations, 2015). However, the 2018 International Energy Agency (IEA) report emphasizes that drastic reductions in the use of fossil fuels are inevitable to reach this goal (IEA, 2018). Moreover, although econometric analysis shows that the divestment campaigns are failing in undermining the financial positions of oil and gas companies directly, they are successful in their attempts to influence the public opinion about the use of fossil fuels (Hansen & Pollin, 2020). Furthermore, analysis of the changed market dynamics because of the coronavirus pandemic leads to the conclusion that "divestments have become a *necessity* for many weak producers in the oil shale industry" (Deloitte, 2020). Hence, it is relevant to examine the market reaction to these divestments.

The results in this study show that the market reacts positively to announcements of oil and gas firms to completely get rid of certain business units. In addition, there is evidence for higher abnormal returns of the selling company's stock if the company has higher levels of proved oil and gas reserves. An explanation for this is the negative effect of the level of oil and gas reserves on firm value, which is confirmed in previous studies (Atanasova & Schwartz (2019); Misund & Osmundsen (2017)). Therefore, the results in this paper suggest that when the company announces to divest a polluting unit that uses oil and gas reserves, it might send a credible signal to the market that it wants to get rid of the reserves. This could explain the positive effect of the level of oil and gas reserves on the stock performance of the parent company from a divestment announcement.

The remainder of this paper is organized in the following way. First of all, Chapter 2 provides a review of the existing literature regarding divestments. It covers the factors considered in divestment decision-making and the market reaction to divestment announcements. Furthermore, it discusses the role of divestments in the oil and gas industry and the difference between forced and voluntary divestments. Chapter 2 ends with the development of hypotheses. Subsequently, Chapter 3 explains which data are used and how the sample is selected. Chapter 4 discusses the event study methodology and regressions that are conducted in this study. Subsequently, Chapter 5 provides the results of the analyses. Finally, Chapter 6 presents a discussion and conclusion of the main findings and related suggestions for further research.

# CHAPTER 2 Literature Review

This chapter discusses the existing literature on corporate divestitures. First, the motives behind divestitures and the existing event studies regarding the announcement are reviewed. Subsequently, the chapter discusses the difference between forced and voluntary divestitures and explains the role of divestments in the oil and gas industry. Lastly, testable hypotheses are derived from the literature.

## 2.1 Prior literature on divestitures

### 2.1.1 Divestment decision-making

As the 1980s was an intense period of corporate restructuring in large U.S. firms, divestiture activity became a trending topic in the empirical literature of the 1990s. Although divestments as mandatory and financially unfavourable events are historically associated with failure, they can also be voluntary choices (Duhaime & Grant, 1984). Hence, one area of interest was the motive behind divestment decisions.

A field study on the 1979 '*Fortune 500*' industrials in the United States shows a strong relationship between the choice to divest and low overall firm financial strength as measured by a low return on equity (ROE) compared to industry averages (Duhaime & Grant, 1984). Remarkably, in this study, other traditional financial strength measures, such as the debt to equity ratio, do not show a significant relation with the divestment decision. Hence, this indicates that only the financial strength in comparison with the industry rather than a firm's own prior records seem to matter for the divestment decision. Moreover, both low unit-level financial strength and competitive strength are strongly related to the divestment decision. Also, a unit is more likely to be divested if it shows a lower degree of interdependency with other units in the firm, for example with low levels of shared technology. In addition, a firm is more likely to divest when it has a higher number of business units, which suggests that the firm wants to refocus (Steiner, 1997). In contrast, the divestment decision does not seem to be related to the general economic environment and managerial attachment to the unit.

Another factor that could influence the divestiture decision is the firm's ownership structure. For example, a study on *Fortune 500* firms shows that blockholder ownership is a significant determinant of divestiture activity in the 1980s (Bethel & Liebeskind, 1993). Hence, large shareholders have both the incentives and power to pressure managers into value-enhancing divestments, which is in line with agency theory. Moreover, empirical results show that the probability of a sell-off is lower when the level of ownership by officers and directors is higher (Steiner, 1997). An explanation for this is that managers value firm level diversification, as both their human and financial capital are tied to the firm. Therefore, sell-offs are not in line with management's desire for firm level diversification. Another reason is that under high managerial ownership “manager-specific” assets become a more valuable tool to reduce the likelihood of being replaced. Since only specific managers are capable to exploit the assets, these assets have a unique value to the firm and its shareholders. As a result, managers could be reluctant to engage in sell-offs, when their level of ownership is high.

Furthermore, several studies point to financial distress as a driver of the divestment decision. In particular, sell-offs could be used as a way of generating cash to pay down debt when the firm is financially constrained (Lang, Poulsen & Stulz, 1995). Subsequently, reduction in leverage could mitigate agency problems driven by information asymmetry and excess debt, and benefit both shareholders and banks (Shin & Groth, 2012). In line with this, firms prefer sell-offs to spin-offs when they are in financial distress (Nixon, Roenfeldt & Sicherman, 2000). Moreover, a firm is more likely to execute a sell-off when the operating profit margin is lower and long-term debt is higher, which also signals to financial distress (Steiner, 1997). Hence, financial distress could elicit a responsive action to divest business units, which fits the traditional resource-based view of divestitures.

In contrast, the knowledge-based view regards divestitures as proactive actions. This view differs from the resource-based view in that firms could have an incentive to engage in a divestiture, without the existence of financial pressure (Lee & Roh, 2020). Central to the knowledge-based view is the desire to improve a firm’s sustainable competitive advantage over rivals and increase knowledge. According to this view, divestitures not merely spur innovative activities, but also enhance corporate sustainability. Empirical results confirm that firms increase their R&D activities following divestitures.

### 2.1.2 Divestment announcements and stock market reactions

Besides the study of the motives behind divestitures, previous empirical studies in the field of finance have mostly focused on stock market reactions to divestiture announcements (Moschieri & Mair, 2008). Table 1 provides an overview of event studies on divestitures over time.

**Table 1:** Overview of Event Studies on the Stock Market Reaction to Divestiture Announcements

| **Author(s)** | **Event Study Methodology** | **Normal Returns model** | **Event Window** | **Estimation Period** | **Abnormal Returns Parent Company** |
|---|---|---|---|---|---|
| **Alexander, Benson & Kampmeyer (1984)** | Brown & Warner (1980) | Mean Adjusted Return model | [-1, 0] | [-150,-31] | Positive |
| **Rosenfeld (1984)** | Brown & Warner (1980) | Mean Adjusted Return model | [-1,0] | [-150, -31] | Positive |
| **Klein (1986)** | Brown & Warner (1985) | Market model | [-2,0] | [-150,-50] | Positive |
| **Hearth & Zaima (1984)** | Brown & Warner (1980) | Market model | [-5,5] | [-150, -50] | Positive |
| **Hearth & Zaima (1986)** | Brown & Warner (1980, 1985) | Mean Adjusted Return model | [-1,0] | [-240, -121] | Positive |
| **Hite, Owers & Rogers (1987)** | Dodd & Warner (1983) | Market model | [-1,0] | [-400, -201] | Positive |
| **Hirschey & Zaima (1989)** | Patel (1976) James (1987) | Market model | [-1,0] | [-240,-121] | Positive |
| **Hirschey, Slovin & Zaima (1990)** | Brown & Warner (1980, 1985) | Mean Adjusted Return model | [-1,0] | [-240, -121] | Positive |
| **Afshar, Taffler & Sudarsanam (1992)** | Brown & Warner (1980, 1985) | Market model | [-1,0] | [-180, -41] | Positive |
| **Sicherman & Pettway (1992)** | Mikkelson & Partch (1988) | Market model | [-1,0] | [-280, -30] | Positive |
| **John & Ofek (1995)** | Brown & Warner (1980) | Market model | [-2,0] | [-252, -2] | Positive |
| **Lang, Poulsen & Stulz (1995)** | Brown & Warner (1980) | Market model | [-1,0] | [-250,-50] | Positive |
| **Wright & Ferris (1997)** | Brown & Warner (1985)<br><br>Fama, Fisher, Jensen & Roll (1969) | Mean Adjusted Return model | [-10,10] | [-260,-11] | Negative |
| **Datta, Iskandar-Datta & Raman (2003)** | Brown & Warner (1980) | Market model | [-1,0] | [-250,-46] | Positive |

| | | | | | |
|---|---|---|---|---|---|
| **Benou, Madura & Ngo (2008)** | Lang, Stulz, & Walkling (1989)<br><br>Gleason, Mathur, and Singh (2000) | Market model | [-1,1] | [-200, -15] | Positive |
| **Teschner & Paul (2020)** | Campbell, Lo & MacKinlay (1997) | Market model | [-1,1] | [-250,-50] | Positive |
| **Bergh, Peruffo, Chiu, Connelly & Hitt (2020)** | Fama, Fisher, Jensen & Roll (1969)<br><br>Warner, Watts & Wruck (1988) | Market model | [-1,1] | [-250,-50] | Positive |

Overall, the evidence shows a positive impact of divestment announcements on the stock price of the parent company. The empirical results indicate that shareholders, on average, perceive sell-off announcements as positive Net Present Value (NPV) transactions (Rosenfeld, 1984). In general, the literature proposes different hypotheses to explain these share price gains. First, the synergistic hypothesis, otherwise known as the focusing hypothesis, states that divestments enable the firm to improve business focus by eliminating negative synergies (John & Ofek, 1995). Related to this is the strategic fit hypothesis. This hypothesis states that when the divested asset has a higher value for the acquirer than for the parent firm, a selling price premium could lead to abnormal returns for the parent company. The expectation is that the performance of the parent company's remaining assets improves. However, a recent event study finds no substantial evidence for the strategic fit hypothesis (Teschner & Paul, 2020). Second, according to the financing hypothesis, divestments are sometimes a cheaper source of financing than common alternatives (Lang et al., 1995). This is in line with the finding that firms with poor financial performance or high leverage are more likely to divest their assets. Third, the undervaluation hypothesis, otherwise known as the information hypothesis, states that multi-divisional firms might use divestments in order to reduce information asymmetry between the firm and the capital market when the firm is undervalued (Nanda & Narayanan, 1999). An event study shows that share price gains at the announcement are eventually lost when a transaction is unsuccessful, which provides evidence for the synergistic hypothesis rather than the information hypothesis (Hite, Owers & Rogers, 1987). The reason for this is that, according to the information hypothesis, the completion of the sell-off is irrelevant to the parent company's market valuation, because the announcement already conveys information to the market about potential undervaluation. In contrast, the synergy hypothesis implies that the market would link an unsuccessful sell-off transaction to the loss of anticipated synergies, which makes the parent company lose its initial announcement gains.

Besides these hypotheses, the literature discusses specific factors that seem to contribute to the positive abnormal returns arising from divestment announcements. When the divestiture decision is based on a financial rationale, the positive returns are stronger (Bowman & Helfat, 2001). In line with this, abnormal announcement returns seem to higher if the market expects the financial performance of the parent company to worsen over time, and hence corporate action is necessary (Teschner & Paul, 2020). However, such divestment announcements could signal bad news, in particular when the parent company has a 'bankruptcy avoidance' motive (Afshar et al., 1992). If the stock market is already aware of a firm's financial distress, shareholder wealth could increase after a distress sale announcement, because it signals management's action to improve future financial performance. However, if the stock market did not anticipate the distressed condition of the firm, the announcement signals bad news about the firm's financial condition. As a result, the stock price of the firm will decrease.

Furthermore, if parent companies only disclose their intention to divest without an actual disclosure of the price, less or no significant announcement effects are observed (Klein, 1986; Afshar, Taffler & Sudarsanam, 1992; Sicherman & Pettway, 1992). The reason for this is that the disclosure of the transaction price at the announcement reduces information asymmetry and a lack of a transaction price may signal unfavourable information. Another event study only reports abnormal returns for sell-offs in firms with bank debt (Hirschey, Slovin & Zaima, 1990). The reason for this is that the market values the monitoring role of banks, which seem to act as quasi-insiders.

In contrast to these explanations from signaling theory, a more recent study highlights that a screening theory perspective might also explain investors' reaction to divestiture announcements (Bergh, Peruffo, Connelly, Chiu & Hitt, 2020). As mentioned earlier, blockholder ownership seems to be positively related to divestiture activity. In particular, a high level of blockholder ownership reflects a positive belief regarding the firm's future financial performance. Since the capital market has limited information about the parent company's motive behind the divestiture and the expected outcome, it could overcome its information disadvantage by means of this screening mechanism. Empirical results suggest that investors react more positively to divestiture announcements when pre-divestiture blockholder ownership is higher. After all, a pre-divestiture increase in blockholder ownership gives investors a small degree of comfort that big current shareholders are trying to maximize financial performance.

### 2.1.3 Forced divestments

The foregoing literature focuses on the voluntary decision of parent companies to divest a part of their business. Importantly, management is only likely to divest voluntary if the divestiture creates positive shareholder value. However, divestments can also be forced by the government. In particular, firms that operate in the oil & gas, basic materials, and utilities sector are more likely to experience forced divestments (Restrepo-Ochoa & Peña, 2020). Government actions that classify as forced divestments are forced sales and asset seizures, in particular outright expropriations and revoked permits.

Importantly, voluntary and forced divestitures differ in terms of their information flows to the capital market (Boudreaux, 1975). Typically, forced divestments are preceded by pre-expropriation warnings. Therefore two events can be identified: the warning and the forced divestment. The evidence shows that pre-expropriation warnings signal a credible threat to investors. Generally, investors consider the warnings as bad news for the firm's future financial performance, since shareholders are often not compensated for the expropriation. Furthermore, the firm might start expensive legal arbitrations, which increases the likelihood that the sell-off results in a negative net present value transaction.

In general, empirical studies confirm that involuntary divestitures tend to reduce the market value of the parent company (Linn & Rozeff, 1984). First of all, the market might expect that the parent company will not obtain a fair price in a forced sale. Besides that, the forced sale could destroy some monopolistic advantages that the parent company has. Another possibility is that the forced divestiture destroys efficient asset structures, which increases costs and decreases cash flows. However, following the warnings, not all forced divestments are associated with significantly negative market reactions (Restrepo-Ochoa & Peña, 2020). Specifically, the market corrects the bad news that it incorporates between the warning and the actual sale. Information leakages about the parent firm's behaviour in the sale will cause uncertainty to resolve. Eventually, negative expectations about the deal are corrected, which may lead to a positive market response at the time of the forced divestment.

### 2.1.4 Divestments in the oil and gas industry

#### 2.1.4.1 Stranded asset risk

As mentioned earlier, the oil and gas industry is prone to divestments. As early as 2012, institutional investors highlighted the risk of fossil fuels to become stranded assets because of carbon budgets (Atanasova & Schwartz, 2019). "Stranded assets" are unsustainable assets that suffer from unanticipated or premature write-offs, downward revaluations or conversion to liabilities as a result of regulatory or environmental pressure. For instance, regulatory changes, such as carbon budgets, could make fossil fuel reserves obsolete. Other risk factors include the evolution of social norms about the use of fossil fuel versus the use of clean energy and falling costs to implement clean technology.

An example of an important regulatory change that contains a carbon budget is the 2015 Paris Agreement, which marks the worldwide consensus of governments to limit global warming to a specified increase of 1.5 degrees Celsius (United Nations, 2015). On 12 December 2015, world leaders adopted the legally binding international treaty on climate change in Paris at the United Nations climate change conference (COP21). As emphasized by the 2018 International Energy Agency report, drastic reductions in the use of fossil fuels are inevitable to achieve the goal of the Paris Agreement (IEA, 2018).

Importantly, the capital market prices stranded asset risk. For instance, to capture a regulatory change like the Paris Agreement, investors take into account climate policy risk when pricing stranded asset risk. Another option for investors to manage climate risks is to divest their stakes in fossil fuel companies (Krueger, Sautner & Starks, 2020). In particular, under modern portfolio theory, the results show that investors can improve their risk-adjusted returns by divesting their stakes in fossil fuel companies and including clean energy producers (Henriques & Sadorsky, 2018). In line with this, fossil fuel divestment is not related to an impairment of portfolio performance (Trinks, Scholtens, Mulder & Dam, 2018). In addition, over the past years, U.S. universities, foundations, governments, and other organizations have invested heavily in fossil fuel divestment campaigns (Ansar, Caldecott & Tilbury, 2013). These campaigns try to encourage investors to sell their stakes in companies that supply oil and gas.

#### 2.1.4.2 Path dependence in renewable energy investments and the impact of oil and gas reserves

On a firm-level, there might be path dependence in renewable energy investments, which means that past investments have an impact on present investments (Wüstenhagen & Menichetti, 2012). This could imply that past investments in fossil fuels affect the risk-return perception of managers in oil companies. As a result, oil companies might miss out on opportunities in the field of renewable energy. In accordance with this, environmental citizenship, among which the engagement of oil and gas companies in renewable energy projects, has a positive impact on management commitment to investment in renewable energy (Hartmann, Inkpen & Ramaswamy, 2021). For example, both Royal Dutch Shell and BP have been making a conscious effort to capture their share in the renewable energy market. In contrast, their U.S. oil peer ExxonMobil is attacked by critics for its lack of commitment to curb its fossil fuel production. In line with Pickl (2019), statistics show that, amongst all oil majors, ExxonMobile has had the highest amount of fossil fuel reserves over the past years, which is in line with the lack of renewable energy strategies at ExxonMobile (Thomson Reuters, 2016).

Related to path dependence, there seems to be a linkage between the proved oil reserves a company has and its renewable energy strategies (Pickl, 2019). Proved oil reserves refer to the quantities of oil that, with a reasonable level of certainty, are expected to be economically recoverable from a given date forward, from known reservoirs and under existing economic conditions, operating methods, and government regulations. In particular, producers with a lower amount of proved oil reserves are choosing to invest in renewable energy more quickly (Pickl, 2019).

Besides the effect of proved oil and gas reserves on management's decisions, the reserves might also affect firm value and stock returns. Results show that, particularly after the 2015 Paris Agreement, the market penalizes the growth of oil producers' total proved fossil fuel reserves more heavily (Atanasova & Schwartz, 2019). Accordingly, the growth of these reserves seems to have a negative effect on firm value. Furthermore, when total proved reserves is decomposed in developed proved reserves and undeveloped proved reserves, the negative effect is particularly due to the growth of undeveloped proved reserves, which are the stranded assets. This can be explained by the high amount of capital expenditures and required time to extract the undeveloped reserves. Extraction of these stranded assets is unprofitable, because of the implementation of the Paris Agreement and necessary reduction in $CO_2$ emissions. On the contrary, a study into the relationship between shareholder returns and the different types of reserves classifications finds that proved developed reserves are the main type of reserves used by investors to forecast future cash flows (Misund & Osmundsen, 2017). In contrast to Atanasova & Schwartz (2019), this implies that investors are not able to efficiently price the changes in the less mature undeveloped reserves.

#### 2.1.4.3 The relation between the oil price and stock returns

Importantly, the business models of renewable energy companies and oil companies are not the same (Pickl, 2019). In contrast to the low price risk related to a large up-front capital expenditure and steady incoming cash flows for renewable energy companies, oil companies face oil price risk. Related to this, the relation between the oil price and stock returns has been widely researched. A firm-level analysis shows that the stock prices of oil companies in the upstream and downstream sectors of the oil supply chain respond differently to changes in benchmark crude oil prices (Swaray & Salisu, 2018). An increase in the oil price positively affects the stock price of upstream sector firms, but negatively affects the stock price of downstream sector firms. In the short run, stock returns in both downstream and upstream sectors increase after an increase in the oil price.

The literature proposes different hypotheses to explain oil firms' exposure to oil price risk. The cash flow hypothesis assumes a negative relation between the oil price and stock returns. The hypothesis proposes that the reaction of stock prices to oil price shocks can be explained by the effect on current and future real cash flows or current and future changes in expected returns (Jones & Kaul, 1996). The higher the oil price, the lower the future cash flows and the higher the expected inflation. Hence, nominal interest rates to discount stock prices become higher, which results in lower stock prices. In contrast, the demand- and supply-side hypotheses are based on the idea that stock return variation comes from variation in risk premia, instead of variation in expected cash flows or interest rates (Killian & Park, 2009). The hypotheses state that stock return responses are dependent on whether a supply or demand shock causes the oil price increase. While demand shocks that reflect uncertainty about future oil supply shortfalls result in declining stock prices, supply disruptions do not seem to have a significant effect on stock returns. However, unanticipated global economic expansion does seem to result in positive effects on stock returns.

## 2.2 Formulation of Hypotheses

The empirical results in Table 1 suggest that, on average, shareholders perceive sell-off announcements as positive Net Present Value (NPV) transactions. To test whether this result still holds in the oil and gas industry, the first hypothesis I intend to test is:

$H1_{0}$: The divestment announcement has no impact on the distribution of returns of the parent firm's stock.
$H1_{\alpha}$: The divestment announcement has a positive impact on the distribution of returns of the parent firm's stock.

Furthermore, the 2015 Paris Agreement highlights the importance of a reduction in the use of fossil fuels and seems to have increased the awareness of stranded asset risk amongst investors. The treaty was adopted on 12 December 2015, but entered into force on 4 November 2016. Hence, from the beginning of 2016 both oil and gas companies and investors could anticipate the need to divest from fossil fuels. Therefore, the expectation is that oil and gas companies are more likely to divest from 2016 onwards. Hence, the second hypothesis I derive is:

$H2_{0}$: The implementation of the Paris Agreement has no effect on the abnormal returns of the parent company from a divestment announcement.
$H2_{\alpha}$: The implementation of the Paris Agreement positively affects the abnormal returns of the parent company from a divestment announcement.

Furthermore, the empirical literature shows that proved reserves affect the market valuation of firms. In particular, undeveloped proved reserves affect firm value through stranded asset risk. The expectation is that high levels of oil and gas reserves motivate parent companies to divest polluting units that require the use of these reserves, because of the negative effect on firm value. Consequently, a divestment is valued positively by the market. Therefore, the third hypothesis I intend to test is:

$H3_{0}$: The amount of proved oil and gas reserves a parent company has, does not affect the abnormal returns of the parent company from a divestment announcement.
$H3_{\alpha}$: A higher amount of proved oil and gas reserves is associated with higher abnormal returns of the parent company from a divestment announcement.

Lastly, the literature highlights the importance of oil price risk for oil and gas firms. A high oil price could incentivise oil and gas firms to invest in new oil and gas projects, rather than to divest current oil and gas assets. So, the fourth hypothesis I derive is:

$H4_0$: The oil price has no effect on the incentive of oil and gas firms to divest.
$H4_a$: The higher the oil price, the less inclined oil and gas firms are to divest.

### *2.3 Chapter Summary*

This chapter discussed prior literature on divestitures. It explained that low firm financial strength, low unit-level financial and competitive strength, a low degree of unit interdependency and a higher number of business units are related to a higher likelihood of divestitures. Other factors that the literature showed to be related to the divestment decision are a high degree of blockholder ownership, financial distress as explained by the traditional resource-based view of divestitures and a proactive action to improve the sustainable competitive advantage as proposed by the knowledge-based view. Furthermore, Table 1 indicated that over time most event studies on divestment announcements found positive abnormal returns around the announcement date for the parent company's stock. Besides that, the chapter discussed the difference between voluntary and forced divestitures. While forced divestment announcements are most likely to result in negative share price reactions, voluntary divestitures are only likely when management expects to create positive shareholder value. Furthermore, the literature showed that the capital market prices stranded asset risk in the oil and gas industry. Investors may improve their returns by divesting their stakes in oil and gas companies. Lastly, the literature highlights the importance of prior investments in green energy and the development of the oil price for the incentive of companies to divest.

# Chapter 3 Data

Table 1 shows that the majority of event studies on divestment announcement effects are executed on U.S. data. With this study I aim to expand the existing knowledge on divestment announcement effects, and therefore I choose to focus on more recent U.S. data with an analysis of one particular industry, that is the oil and gas industry. As mentioned earlier, companies in this industry are bound to think about their renewable energy strategies, as they are faced with climate policy and divestment campaigns. Hence, the main divestiture method of oil and gas firms are sell-offs, as they want to completely get rid off a polluting unit or asset in order to save their reputation. Therefore, this study focuses on sell-offs and does not include spin-offs, as in the latter case the sale to the parental firm's shareholders does not completely cut ties with the parent company. So, this study covers sell-offs in the U.S. oil and gas industry in the period 2004-2021.

The Thomson One M&A database provides the divestment announcement dates. Parent companies are selected based on their primary SIC code, which has to be part of the oil and gas industry. As this study focuses on the oil and gas industry, primary SIC codes that contain the description "coal" are excluded. Acquirers of the divested assets in the sample are allowed to be active in all industries. In order to be able to estimate shareholder wealth effects, the divesting parent company is required to be a listed company.

Furthermore, certain restrictions are imposed on the sell-offs. First of all, percentage of shares owned by the acquiring company after the sell-off must be 100%. The reason for this is that this study assumes that the company wants to completely get rid of the polluting unit or asset. Besides that, to make sure that the sample only contains sell-offs that are likely to affect shareholder value, the deal value is set to a minimum value of 10 million U.S. dollars. Furthermore, only divestment announcements which the database labels as 'friendly' are kept in order to ensure that all of the divestments in the sample are voluntary. As discussed in *§2.1.3*, forced divestments have a higher likelihood to negatively affect shareholder value. Hence, forced divestments are not similar to voluntary divestments and therefore they are excluded from the sample. Lastly, as the analysis requires a reliable event date, all announcements need to contain an official announcement date.

With these initial selection criteria the Thomson One M&A database gives a sample of 870 divestment announcements from 233 parent companies. Subsequently, I account for missing data by removing them from the sample, which is summarized in Table 2. The final sample consists of 300 voluntary divestment announcements from 48 different parent companies.

**Table 2:** Sample Selection Process of the Full Sample

| Process | Number of Divestment Announcements | Number of Firms |
|---|---|---|
| Initial sample Thomson One M&A Database | 870 | 233 |
| No data for Proved oil and gas reserves | *475* | *170* |
| No data for ROA | *1* | *0* |
| No data for SEDOL* | *1* | *1* |
| Incomplete data in Datastream Event Study Tool | *93* | *14* |
| Total number of announcements (column 2) and firms (column 3) removed | *(570)* | *(185)* |
| **Final sample** | **300** | **48** |

**Divestment announcements with a missing Stock Exchange Daily Official List (SEDOL) code are deleted, as the SEDOL code is a required identifier for the Datastream Event Study tool.*

Table 3 provides an overview of the SIC codes of the parent companies that are included in the sample. Crude petroleum and natural gas is the primary business of the majority of the sample.

**Table 3:** Overview of SIC Codes of Parent Companies in the Full Sample

| Primary SIC Code Parent Company | SIC Code Description | Amount of Divestment Announcements | Of which Domestic | Of which International | Amount of Firms |
|---|---|---|---|---|---|
| 1311 | Crude petroleum and natural gas | 237 | 130 | 107 | 44 |
| 1382 | Oil and gas field exploration services | 3 | 2 | 1 | 1 |
| 2911 | Petroleum refining | 60 | 32 | 28 | 3 |
| **Total** | | **300** | 164 | 136 | **48** |

The independent variables in this study are the Paris Agreement, the oil and natural gas reserves of the firm and the oil price. For the Paris Agreement a dummy variable is created which is equal to 1 when the Paris Agreement is most likely to affect oil and gas companies' decisions, i.e., as of the year 2016, and equal to 0 for the years 2004 up to and including 2015. The data on oil and natural gas reserves are retrieved from the WRDS (North America) Industry Specific database, which contains specific variables for the oil and gas industry. Natural gas reserves are measured in millions of cubic feet and oil reserves are measured in thousands of barrels. Proved developed, undeveloped and total reserves are measured at the end of the year. Subsequently, following Atanasova & Schwartz (2019), all measures of reserves are scaled by the total assets of the firm. Furthermore, The West Texas Intermediate (WTI) oil price is obtained from Datastream and serves as the oil price variable in this study, as it is the U.S. oil price benchmark. It is measured in U.S. dollars per barrel.

Furthermore, WRDS Compustat (North America) provides accounting data to create the control variables in this paper. Control variables in this study are the size of the company, leverage, return on assets (ROA), the deal value and the domestic or international status of the deal. As mentioned earlier, firms with more business units are more likely to divest, because they want to reduce organizational complexity. Therefore, it is assumed that the bigger the size of the firm, the more business units it has, and the more likely it is that it wants to divest. Hence, the size of the firm is a control variable in this study and is measured as the book value of total assets in millions of dollars. Figure A.1 (Appendix A) shows that the distribution of size is skewed to the right. This means that most companies in the sample have a fairly low book value of total assets, but there are also a few outliers with a much higher book value of total assets. Figure A.2 (Appendix A) shows that the natural logarithm of size is more normally distributed and therefore the natural logarithm of size is used in the regression analysis.

Furthermore, the previously discussed empirical literature suggests that financially distressed firms with a higher leverage ratio are more likely to divest, as the divestment generates cash to pay down debt. Hence, leverage is another relevant control variable and is calculated as the amount of total debt relative to total assets. Related to this, firms with poor financial performance might also be more likely to divest certain business units. A commonly used measure of financial performance is the return on assets (ROA), which is calculated as operating income before depreciation divided by total assets. As mentioned earlier, the asset turnover ratio is a common measure of investment efficiency. However, when there is no *a priori* base to establish where financial performance comes from, it is more suitable to capture both the profit margin and the asset turnover (Daley, Mehrotra & Sivakumar, 1997). As this study only broadly assumes a relation between financial performance and the likelihood to divest, it seems appropriate to use ROA to capture financial performance instead of the narrower defined asset turnover. Furthermore, deal value is another control variable, as more material deals are more likely to have a bigger effect on the abnormal returns than smaller deals. Figure A.3 (Appendix A) shows that deal value, which is measured in millions of dollars, is not normally distributed. Therefore, I take the natural logarithm of deal value in the regressions, which is more normally distributed, as Figure A.4 (Appendix A) confirms.

Furthermore, Table 4 provides descriptive statistics for the domestic divestments in the sample. Proved natural gas reserves, both developed and undeveloped, show more variation than the oil reserves. Figure

A.5 (Appendix A) shows the frequency distribution and normal density curve of the Cumulative Abnormal Return (CAR) (-1;+1) in the sample of domestic divestments. The figure shows a clear outlier.

**Table 4:** Descriptive Statistics for Domestic Divestments

| **Variable** | **N** | **Mean** | **Std. Dev.** | **Min.** | **Q1** | **Median** | **Q3** | **Max.** |
|---|---|---|---|---|---|---|---|---|
| **CAR (-1;+1)** | 164 | 0.01 | 0.06 | -0.13 | -0.02 | 0.00 | 0.03 | 0.48 |
| **Proved developed oil reserves** | 164 | 18.82 | 11.24 | 0.15 | 11.37 | 15.57 | 25.07 | 60.08 |
| **Proved developed natural gas reserves** | 164 | 143.42 | 111.35 | 9.16 | 75.45 | 130.11 | 186.25 | 1034.73 |
| **Proved undeveloped oil reserves** | 164 | 13.67 | 11.29 | 0.00 | 7.15 | 10.97 | 17.96 | 101.40 |
| **Proved undeveloped natural gas reserves** | 164 | 83.65 | 100.15 | 0.00 | 24.57 | 48.37 | 107.27 | 781.91 |
| **Total proved oil reserves** | 164 | 32.48 | 19.51 | 0.51 | 20.14 | 27.65 | 40.58 | 149.76 |
| **Total proved natural gas reserves** | 164 | 227.07 | 199.51 | 9.16 | 111.78 | 178.79 | 281.89 | 1816.63 |
| **Oil price** | 164 | 68.15 | 22.57 | 26.21 | 49.86 | 63.44 | 89.81 | 118.65 |
| **Size** | 164 | 64,310.46 | 92,695.04 | 22.80 | 7,653.40 | 24,785.40 | 54,185.00 | 350,000 |
| **Leverage** | 164 | 0.25 | 0.15 | 0.00 | 0.16 | 0.24 | 0.33 | 0.99 |
| **ROA** | 164 | 0.11 | 0.15 | -0.65 | 0.09 | 0.14 | 0.18 | 0.30 |
| **Deal value** | 164 | 559.47 | 941.88 | 10.00 | 103.65 | 271.50 | 591.25 | 7349.06 |
| **Market capitalization** | 163 | 65.00 | 114.00 | 0.01 | 6.20 | 19.20 | 40.00 | 487.00 |

*This table shows descriptive statistics for the domestic divestments in the sample over the time period 2004-2021; as all parent companies are from the United States, divestments are considered as domestic when the acquirer is also based in the United States; the cumulative abnormal return (CAR) is the sum of the abnormal returns on the day before the divestment announcement (τ=-1), the day of the announcement (τ=0) and the day after the announcement (τ=1); the total number of observations (N), mean, standard deviation (Std. Dev.), minimum (Min.), first quartile (Q1), median, third (Q3) quartile and maximum (Max.) are reported.*

Table 5 shows the *Pearson* correlation coefficients (*r*) for the domestic divestments in the sample. Strong significant correlations ($| r | > 0.5$) are mostly visibly between the oil and gas reserves, which is partially explained by the fact that total proved reserves are the sum of proved developed and proved undeveloped reserves. In addition, following Atanasova & Schwartz (2019), total reserves are not simultaneously included in the regressions with developed and undeveloped reserves. Therefore, there is no indication of multicollinearity in the regressions caused by the correlations with total reserves. However, proved undeveloped oil reserves show a moderate statistically significant correlation with proved developed oil reserves ($r = 0.500$***). Also, proved undeveloped natural gas reserves show a strong statistically significant correlation with proved developed natural gas reserves ($r = 0.779$***). Therefore, there might be multicollinearity in the regressions that include both developed and undeveloped oil and gas reserves.

**Table 5:** Pearson Correlation Coefficients for Domestic Divestments

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(1) CAR (-1;+1)** | 1 | | | | | | | | | | | | |
| **(2) Proved developed oil reserves** | -0.069 | 1 | | | | | | | | | | | |
| **(3) Proved developed natural gas reserves** | 0.075 | -0.118 | 1 | | | | | | | | | | |
| **(4) Proved undeveloped oil reserves** | -0.004 | 0.500*** | -0.050 | 1 | | | | | | | | | |
| **(5) Proved undeveloped natural gas reserves** | 0.057 | -0.166** | 0.779*** | 0.116 | 1 | | | | | | | | |
| **(6) Total proved oil reserves** | -0.042 | 0.865*** | -0.097 | 0.867*** | -0.029 | 1 | | | | | | | |
| **(7) Total proved natural gas reserves** | 0.071 | -0.149* | 0.949*** | 0.030 | 0.937*** | -0.069 | 1 | | | | | | |
| **(8) Oil price** | -0.168** | -0.348*** | -0.192** | -0.110 | -0.046 | -0.264*** | -0.130* | 1 | | | | | |
| **(9) Size** | -0.082 | 0.232*** | -0.059 | -0.029 | -0.126 | 0.117 | -0.097 | 0.009 | 1 | | | | |
| **(10) Leverage** | 0.171** | -0.261*** | 0.180** | 0.107 | 0.210*** | -0.089 | 0.206*** | -0.117 | -0.561*** | 1 | | | |
| **(11) ROA** | -0.179** | 0.241*** | -0.074 | 0.074 | -0.012 | 0.181** | -0.047 | 0.152* | 0.237*** | -0.533*** | 1 | | |
| **(12) Deal value** | -0.010 | -0.073 | -0.123 | -0.136* | -0.110 | -0.121 | -0.124 | 0.022 | -0.052 | 0.033 | 0.030 | 1 | |
| **(13) Market capitalization** | -0.072 | 0.275*** | -0.006 | 0.014 | -0.063 | 0.167** | -0.035 | 0.009 | 0.938*** | -0.571*** | 0.262*** | -0.070 | 1 |

*This table shows Pearson correlation coefficients between the variables in the domestic part of the sample of divestments;* $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

Moreover, Table 6 provides descriptive statistics for the international divestments in the sample. There are slightly less international divestments (**N** = 136) compared to domestic divestments (**N** = 164) in the full sample. Similar to the domestic divestments, the natural gas reserves, both proved developed as proved undeveloped, show more variation than the oil reserves. Besides that, the descriptive statistics in both Table 4 and Table 6 confirm the substantial difference between the lowest and highest firm size and deal value, which justifies the use of the natural logarithm of these variables to account for outliers. Moreover, with a standard deviation of $114,000,000,000 for domestic divestments and $115,000,000,000 for international divestments, the parent companies in the both subgroups are relatively different in terms of their market capitalization.

Figure A.6 (Appendix A) shows the frequency distribution and normal density curve of the Cumulative Abnormal Return (CAR) (-1;+1) for the international divestments in the sample. Similar to the CAR (-1;+1) for domestic divestments, the distribution shows a clear outlier.

**Table 6:** Descriptive Statistics for International Divestments

| Variable | N | Mean | Std. Dev. | Min. | Q1 | Median | Q3 | Max. |
|---|---|---|---|---|---|---|---|---|
| **CAR (-1;+1)** | 136 | 0.01 | 0.06 | -0.12 | -0.02 | 0.00 | 0.03 | 0.30 |
| **Proved developed oil reserves** | 136 | 22.52 | 16.84 | 1.11 | 12.90 | 18.42 | 25.88 | 121.19 |
| **Proved developed natural gas reserves** | 136 | 120.57 | 76.85 | 1.36 | 60.01 | 113.62 | 155.26 | 352.76 |
| **Proved undeveloped oil reserves** | 136 | 14.21 | 10.60 | 0.00 | 7.88 | 12.35 | 18.75 | 78.40 |
| **Proved undeveloped natural gas reserves** | 136 | 59.57 | 57.15 | 0.00 | 24.24 | 41.95 | 67.62 | 359.51 |
| **Total proved oil reserves** | 136 | 36.73 | 23.46 | 2.60 | 22.20 | 32.62 | 45.61 | 180.70 |
| **Total proved natural gas reserves** | 136 | 180.14 | 119.20 | 7.68 | 100.63 | 162.29 | 230.24 | 712.27 |
| **Oil price** | 136 | 71.28 | 23.11 | 34.28 | 49.89 | 63.95 | 92.56 | 120.92 |
| **Size** | 136 | 70,388.07 | 97,352.93 | 54.77 | 6,516.94 | 29,979.50 | 93,208.00 | 360,000 |
| **Leverage** | 136 | 0.27 | 0.25 | 0.01 | 0.12 | 0.22 | 0.30 | 1.32 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **ROA** | 136 | 0.09 | 0.33 | -1.75 | 0.09 | 0.14 | 0.20 | 0.34 |
| **Deal value** | 136 | 746.78 | 1,456.70 | 10.61 | 106.63 | 276.50 | 838.89 | 13,239.80 |
| **Market capitalization** | 133 | 69.60 | 115.00 | 0.03 | 4.50 | 19.70 | 72.00 | 495.00 |

*This table shows descriptive statistics for the international divestments in the sample over the time period 2004-2021; as all parent companies are from the United States, divestments are considered as international when the acquirer is not based in the United States; the cumulative abnormal return (CAR) is the sum of the abnormal returns on the day before the divestment announcement (τ=-1), the day of the announcement (τ=0) and the day after the announcement (τ=1); the total number of observations (N), mean, standard deviation (Std. Dev.), minimum (Min.), first quartile (Q1), median, third quartile (Q3) and maximum (Max.) are reported.*

Table 7 shows the *Pearso*n correlation coefficients (*r*) for the international divestments in the sample. The same inferences apply with regard to the correlation between the reserves and the effect on multicollinearity as in Table 5 for domestic divestments. Furthermore, there is a strong correlation (*r* = 0.929***) between the market capitalization and size of the parent company. However, as the market capitalization is not included in the regressions, there is no reason to assume multicollinearity in the regressions caused by this correlation.

**Table 7:** Pearson Correlation Coefficients for International Divestments

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(1) CAR (-1;+1)** | 1 | | | | | | | | | | | | |
| **(2) Proved developed oil reserves** | 0.246*** | 1 | | | | | | | | | | | |
| **(3) Proved developed natural gas reserves** | -0.089 | -0.079 | 1 | | | | | | | | | | |
| **(4) Proved undeveloped oil reserves** | -0.004 | 0.433*** | -0.027 | 1 | | | | | | | | | |
| **(5) Proved undeveloped natural gas reserves** | 0.011 | -0.019 | 0.574*** | 0.079 | 1 | | | | | | | | |
| **(6) Total proved oil reserves** | 0.175** | 0.913*** | -0.069 | 0.763*** | 0.022 | 1 | | | | | | | |
| **(7) Total proved natural gas reserves** | -0.052 | -0.060 | 0.920*** | 0.021 | 0.849*** | -0.034 | 1 | | | | | | |
| **(8) Oil price** | -0.134 | -0.358*** | 0.004 | -0.149* | -0.027 | -0.324*** | -0.010 | 1 | | | | | |
| **(9) Size** | -0.117 | 0.034 | 0.117 | -0.022 | -0.031 | 0.014 | 0.060 | 0.062 | 1 | | | | |
| **(10) Leverage** | 0.454*** | 0.221*** | -0.179** | -0.009 | 0.078 | 0.154* | -0.078 | -0.232*** | -0.411*** | 1 | | | |
| **(11) ROA** | -0.474*** | -0.215** | 0.245*** | 0.119 | 0.180** | -0.100 | 0.244*** | 0.138 | 0.197** | -0.702*** | 1 | | |
| **(12) Deal value** | 0.078 | -0.090 | 0.066 | -0.095 | -0.148* | -0.107 | -0.028 | 0.008 | 0.110 | -0.098 | 0.070 | 1 | |
| **(13) Market capitalization** | -0.121 | 0.086 | 0.194** | 0.016 | 0.061 | 0.069 | 0.152* | 0.078 | 0.929*** | -0.402*** | 0.197** | 0.061 | 1 |

*This table shows Pearson correlation coefficients for the international part of the sample of divestments;* $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

Table B (Appendix B) reports the results for *Levene's test for equality of variances* between domestic and international divestments. The test is executed in order to determine the appropriate two sample *t*-test for differences in means between domestic and international divestments, i.e., a two sample *t*-test with equal or unequal variances. The test-statistic that is evaluated is the *F* centered at the median instead of the mean, to provide more accurate results for potential asymmetric data (Conover, Johnson & Johnson, 1981). In addition, for symmetric data the *p*-value for *F* centered at the median is similar to the *p*-value for *F* centered at the mean.

Table B (Appendix B) shows that there is a statistically significant difference in the variance of proved undeveloped natural gas reserves (*p* = 0.015**), total proved natural gas reserves (*p* = 0.097*), leverage (*p* = 0.063*) and ROA (*p* = 0.095*) between domestic and international divestments. In addition, the full sample contains less international divestments (**N** = 136) than domestic divestments (**N** = 164). Therefore, a two sample t-test with unequal variances (*Welch's t-test*) is executed to test the differences in means between domestic and international divestments. The results of the *Welch's t-test* are reported in Table 8.

**Table 8:** Differences in Means between Domestic and International Divestments in the Sample (Welch's t-test)

| **Variable** | **International divestments (N)** | **Mean international divestments** | **Domestic divestments (N)** | **Mean domestic divestments** | **Mean difference** | ***t*** | **Sig. (*p*)** |
|---|---|---|---|---|---|---|---|
| **CAR (-1;+1)** | 136 | 0.01 | 164 | 0.01 | 0.002 | 0.234 | 0.815 |
| **Proved developed oil reserves** | 136 | 22.52 | 164 | 18.82 | 3.703 | 2.191 | 0.030** |
| **Proved developed natural gas reserves** | 136 | 120.57 | 164 | 143.42 | -22.847 | -2.094 | 0.037** |
| **Proved undeveloped oil reserves** | 136 | 14.21 | 164 | 13.67 | 0.542 | 0.428 | 0.669 |
| **Proved undeveloped natural gas reserves** | 136 | 59.57 | 164 | 83.65 | -24.082 | -2.609 | 0.010*** |
| **Total proved oil reserves** | 136 | 36.73 | 164 | 32.48 | 4.245 | 1.682 | 0.094* |
| **Total proved natural gas reserves** | 136 | 180.14 | 164 | 227.07 | -46.929 | -2.519 | 0.012** |
| **Oil price** | 136 | 71.28 | 164 | 68.15 | 3.124 | 1.178 | 0.240 |
| **Size** | 136 | 70,388.07 | 164 | 64,310.46 | 6,077.61 | 0.550 | 0.583 |
| **Leverage** | 136 | 0.269 | 164 | 0.254 | 0.015 | 0.615 | 0.539 |
| **ROA** | 136 | 0.086 | 164 | 0.115 | -0.028 | -0.937 | 0.350 |
| **Deal value** | 136 | 746.78 | 164 | 559.47 | 187.31 | 1.292 | 0.198 |
| **Market capitalization** | 133 | 69.60 | 163 | 65.00 | 4.645 | 0.347 | 0.729 |

*This table shows the t-test results for a difference in the mean of each variable; mean difference = mean (international) – mean (domestic); the total number of observations (N), means, mean difference, test-statistic (t) and significance (Sig. (p)) are reported; * p < 0.10, ** p < 0.05, *** p < 0.01.*

Table 8 shows that proved developed oil reserves (*p* = 0.030**) and total proved oil reserves (*p* = 0.094*) are significantly lower in parent companies that decide to execute domestic divestments compared to the execution of international divestments. In contrast, proved developed natural gas reserves (*p* = 0.037**), proved undeveloped natural gas reserves (*p* = 0.010***) and total proved natural gas reserves (*p* = 0.012**) are significantly higher in parent companies that decide to execute domestic divestments compared to the execution of international divestments. Hence, the level of oil and gas reserves might be different between parent companies who engage in domestic divestments and those that engage in international divestments. As the effect of oil and gas reserves on the cumulative abnormal returns of parent companies is analyzed in this study, a dummy variable *Domestic* is added to the regressions as a control variable.

In addition, Table 9 shows descriptive statistics for the full sample. Over time, Exxon Mobil reached the highest market capitalization of $495,000,000,000 in the sample. Other big oil companies in the sample are Chevron and ConocoPhillips. On the contrary, the sample also consists of much smaller oil companies, for instance Infinity Energy Resources Inc, which reached the lowest market capitalization of $10,901,310 in the sample. Apparently, the U.S. oil and gas industry consists of a variety of smaller companies. Hence, the sample consists of a mixture of small and big oil and gas companies. Because of the large difference between the lowest market capitalization of $10,901,310 and highest market capitalization of $495,000,000,000, the distribution of the market capitalization in the sample seems skewed. Its frequency distribution and normal density curve in Figure A.7 (Appendix A) confirms that the distribution is skewed to the right. Therefore, the best measure of central tendency for this variable is the median market capitalization of $19,200,000,000 instead of the mean.

**Table 9:** Descriptive Statistics for the Full Sample

| Variable | N | Mean | Std. Dev. | Min. | Q1 | Median | Q3 | Max. |
|---|---|---|---|---|---|---|---|---|
| **CAR (-1;+1)** | 300 | 0.01 | 0.06 | -0.13 | -0.02 | 0.00 | 0.03 | 0.48 |
| **Proved developed oil reserves** | 300 | 20.49 | 14.15 | 0.15 | 11.84 | 17.34 | 25.18 | 121.19 |
| **Proved developed natural gas reserves** | 300 | 133.06 | 97.75 | 1.36 | 75.92 | 125.03 | 168.21 | 1034.73 |
| **Proved undeveloped oil reserves** | 300 | 13.91 | 10.97 | 0.00 | 7.47 | 11.66 | 18.04 | 101.40 |
| **Proved undeveloped natural gas reserves** | 300 | 72.74 | 84.18 | 0.00 | 24.24 | 45.31 | 88.99 | 781.91 |
| **Total proved oil reserves** | 300 | 34.41 | 21.46 | 0.51 | 20.63 | 30.85 | 43.70 | 180.70 |
| **Total proved natural gas reserves** | 300 | 205.80 | 169.30 | 7.68 | 109.31 | 172.75 | 259.09 | 1,816.63 |
| **Oil price** | 300 | 69.57 | 22.83 | 26.21 | 49.89 | 63.60 | 91.88 | 120.92 |
| **Size** | 300 | 67,065.64 | 94,723.28 | 22.80 | 7,355.40 | 25,913.00 | 70,247.00 | 360,000 |
| **Leverage** | 300 | 0.26 | 0.20 | 0.00 | 0.14 | 0.23 | 0.33 | 1.32 |
| **ROA** | 300 | 0.10 | 0.25 | -1.75 | 0.09 | 0.14 | 0.20 | 0.34 |
| **Deal value** | 300 | 644.38 | 1,204.34 | 10.00 | 104.63 | 274.00 | 735.00 | 13,239.80 |
| **Market capitalization** | 296 | 67.10 | 114.00 | 0.01 | 5.40 | 19.20 | 51.00 | 495.00 |

*This table shows descriptive statistics for the full sample of divestments over the time period 2004-2021; the cumulative abnormal return (CAR) is the sum of the abnormal returns on the day before the divestment announcement (τ=-1), the day of the announcement (τ=0), and the day after the announcement (τ=1); the total number of observations (N), mean, standard deviation (Std. Dev.), minimum (Min.), first quartile (Q1), median, third quartile (Q3) and maximum (Max.) are reported.*

Table 10 shows the *Pearson* correlation coefficients (*r*) for the full sample. The full sample is a merge of domestic and international divestments. Therefore, the conclusion holds that, compared to other variables, the strongest correlations are visible between the oil and gas reserves.

**Table 10:** Pearson Correlation Coefficients for the Full Sample

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(1) CAR (-1;+1)** | 1 | | | | | | | | | | | | |
| **(2) Proved developed oil reserves** | 0.097* | 1 | | | | | | | | | | | |
| **(3) Proved developed natural gas reserves** | 0.017 | -0.106* | 1 | | | | | | | | | | |
| **(4) Proved undeveloped oil reserves** | -0.004 | 0.451*** | -0.044 | 1 | | | | | | | | | |
| **(5) Proved undeveloped natural gas reserves** | 0.040 | -0.111* | 0.730*** | 0.097* | 1 | | | | | | | | |
| **(6) Total proved oil reserves** | 0.062 | 0.890*** | -0.093 | 0.808*** | -0.024 | 1 | | | | | | | |
| **(7) Total proved natural gas reserves** | 0.030 | -0.117** | 0.941*** | 0.023 | 0.919*** | -0.065 | 1 | | | | | | |
| **(8) Oil price** | -0.152*** | -0.334*** | -0.124** | -0.126** | -0.047 | -0.285*** | -0.095* | 1 | | | | | |
| **(9) Size** | -0.097* | 0.121** | 0.003 | -0.025 | -0.095 | 0.067 | -0.045 | 0.036 | 1 | | | | |
| **(10) Leverage** | 0.315*** | 0.067 | 0.001 | 0.041 | 0.126** | 0.065 | 0.063 | -0.176*** | -0.459*** | 1 | | | |
| **(11) ROA** | -0.333*** | -0.097* | 0.094 | 0.093 | 0.077 | -0.017 | 0.093 | 0.129* | 0.196*** | -0.656*** | 1 | | |
| **(12) Deal value** | 0.038 | -0.073 | -0.041 | -0.108* | -0.121** | -0.103* | -0.084 | 0.001 | 0.043 | -0.053 | 0.054 | 1 | |
| **(13) Market capitalization** | -0.093 | 0.168*** | 0.062 | 0.015 | -0.025 | 0.119** | 0.023 | 0.042 | 0.934*** | -0.457*** | 0.204*** | 0.005 | 1 |

*This table shows Pearson correlation coefficients for the full sample of divestments; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

Figure A.8 (Appendix A) shows the frequency distribution and normal density curve of the Cumulative Abnormal Return (CAR) (-1;+1) for the full sample. As the full sample is a summation of the domestic and international divestments, its CAR (-1;+1) distribution shows clear outliers at the high end of the distribution. Therefore, to make the CAR more normally distributed as a dependent variable in the regression analysis, the CAR (-1;+1) is winsorized at the 1th and 99th percentiles.

Lastly, the acquirer can pay for the sell-off using cash, stocks or a mixture of cash and stocks. In general, the acquirer prefers to pay in stocks when its own shares are overvalued (Martynova & Renneboog, 2008). In addition, higher investment opportunities are another reason for the acquirer to use stock financing (Martin, 1992). Stock financing delivers lower constraints for current and future investments compared to cash financing. Logically, investors of the parent company would value payment in stock differently than payment in cash, in particular when the acquirer's shares are overvalued. Hence, stock financing of the acquirer could affect the abnormal return of the selling parent company. Therefore, a categorical variable *Payment* is created which accounts for the method of payment of the acquirer. Possible methods of payment are 100% cash, 100% stock, 100% other (i.e., total value paid minus cash and stock) or a combination of cash, stock, and/or other. As shown in Table 11, an additional sample is selected, which is created by deleting divestments with missing payment data from the full sample. The additional sample consists of 162 divestment announcements from 41 different parent companies. As shown, the majority of the divestments are paid by cash.

**Table 11:** Sample Selection Process for the Additional Sample

| Process | Number of Divestment Announcements | Number of Firms |
|---|---|---|
| Initial sample in Thomson One M&A database | 870 | 233 |
| No data for Proved oil and gas reserves | *475* | *170* |
| No data for ROA | *1* | *0* |
| No data for SEDOL | *1* | *1* |
| No data for method of payment | *179* | *9* |
| Incomplete data in Datastream Event Study Tool | *52* | *12* |
| Total number of announcements (column 2) and firms (column 3) removed | *(708)* | *(192)* |
| **Additional sample** | **162** | **41** |
| Cash (100%) | 98 | |
| Stock (100%) | 2 | |
| Other (100%) | 34 | |
| Cash + Stock | 6 | |
| Stock + Other | 2 | |
| Cash + Other | 19 | |
| Cash + Stock + Other | 1 | |

Table 12 shows the descriptive statistics for the additional sample.

**Table 12:** Descriptive Statistics for the Additional Sample

| Variable | N | Mean | Std. Dev. | Min. | Q1 | Median | Q3 | Max. |
|---|---|---|---|---|---|---|---|---|
| **CAR (-1;+1)** | 162 | 0.01 | 0.07 | -0.13 | -0.02 | 0.00 | 0.03 | 0.48 |
| **Proved developed oil reserves** | 162 | 20.54 | 15.06 | 0.15 | 12.04 | 17.39 | 25.06 | 121.19 |
| **Proved developed natural gas reserves** | 162 | 123.11 | 86.02 | 1.36 | 64.10 | 113.63 | 150.56 | 614.20 |
| **Proved undeveloped oil reserves** | 162 | 14.61 | 12.68 | 0.00 | 7.36 | 11.98 | 17.97 | 101.40 |
| **Proved undeveloped natural gas reserves** | 162 | 65.33 | 74.67 | 0.00 | 20.23 | 41.81 | 71.40 | 509.19 |
| **Total proved oil reserves** | 162 | 35.15 | 23.19 | 0.51 | 21.28 | 31.56 | 40.68 | 180.70 |
| **Total proved natural gas reserves** | 162 | 188.45 | 144.94 | 7.68 | 103.03 | 157.29 | 230.24 | 1123.39 |
| **Oil price** | 162 | 67.32 | 21.19 | 26.21 | 49.59 | 62.14 | 87.06 | 120.92 |
| **Size** | 162 | 58,211.73 | 95,198.05 | 42.30 | 4,448.68 | 19,879.00 | 50,014.00 | 360,000 |
| **Leverage** | 162 | 0.29 | 0.21 | 0.00 | 0.16 | 0.26 | 0.34 | 1.32 |
| **ROA** | 162 | 0.08 | 0.26 | -1.75 | 0.07 | 0.14 | 0.18 | 0.31 |
| **Deal value** | 162 | 737.75 | 1,490.07 | 10.61 | 100.00 | 221.07 | 675.00 | 13,239.80 |
| **Market capitalization** | 160 | 54.00 | 103.00 | 0.01 | 2.30 | 14.70 | 33.00 | 418.00 |

*This table shows the descriptive statistics for the additional sample of divestments over the time period 2004-2021; the cumulative abnormal return (CAR) is the sum of the abnormal returns on the day before the divestment announcement (τ=-1), the day of the announcement (τ=0) and the day after the announcement (τ=1); the total number of observations (N), the mean, standard deviation (Std. Dev.), minimum (Min.), first quartile (Q1), median, third quartile (Q3) and maximum (Max.) are reported.*

Finally, Table 13 contains an overview of the SIC Codes of the parent companies in the additional sample. Compared to Table 3, which shows the same information for the main sample, the majority of divestment announcements that had to be excluded in the additional sample were those that are executed by parent companies in the crude petroleum and natural gas industry (SIC Code 1311). The amount of divestments are fairly split between domestic (87) and international (75) divestments.

**Table 13:** Overview of SIC Codes of Parent Companies in the Additional Sample

| Primary SIC Code Parent Company | SIC Code Description | Amount of Divestment Announcements | of which Domestic | of which International | Amount of Firms |
|---|---|---|---|---|---|
| 1311 | Crude petroleum and natural gas | 130 | 68 | 62 | 37 |
| 1382 | Oil and gas field exploration services | 3 | 2 | 1 | 1 |
| 2911 | Petroleum refining | 29 | 17 | 12 | 3 |
| **Total** | | **162** | 87 | 75 | **41** |

# Chapter 4 Methodology

## 4.1 The impact of the divestment announcement on the parent firm's stock return

This paper follows the event study methodology as explained in MacKinlay (1997). With this methodology, cumulative abnormal stock returns around the divestment announcement date show the impact of the divestiture on the stock price of the parent company. In accordance with the majority of previous event studies on stock market reactions in Table 1, the market model is used to model the normal return. The Datastream Event Study Tool is used to obtain the market model parameters and (cumulative) abnormal returns.

According to the market model, the return of parent company $i$ on trading day $t$ is

$$R_{it} = \alpha_i + \beta_i * Rm_t + \varepsilon_{it} \quad (1)$$

where $Rm_t$ is the return on the market portfolio, and $\varepsilon_{it}$ is the error term. The ordinary least squares (OLS) procedure is used to estimate the parameters $\alpha_i$ and $\beta_i$ over the estimation window.

The normal return is the expected return over the event window when the event does not take place. The normal return is

$$\hat{R}_{it} = \hat{\alpha_i} + \hat{\beta_i} * Rm_t \quad (2)$$

Following the most recent event studies in Table 1, the market model parameters are estimated over an estimation window of 200 days (day -250 to day -50) prior to the divestment announcement date to calculate the expected return (Teschner & Paul (2020); Bergh et al. (2020)).

To capture the variety of small and big firms, the return on the market portfolio ($Rm_t$) is captured by the S&P MidCap 400 Index. The S&P MidCap 400 provides investors with a benchmark for mid-sized U.S. companies. As of 28 February 2022, the mean and median market capitalization of the S&P MidCap 400 were approximately \$6,100,000,000 and \$5,450,000,000, respectively (S&P Global, 2022). The largest market capitalization in the index was \$17,920,000,000, while the smallest market capitalization was \$1,370,000,000. As the median market capitalization in the full sample of companies in this study is \$19,200,000,000, the use of the S&P Midcap 400 seems reasonable. To test the robustness of the event study results, a robustness test is performed with the S&P 500 Index as an alternative market benchmark. The S&P 500 provides a benchmark for large-cap U.S. equities.

Then, the abnormal return ($AR$) for parent company $i$ is the difference between the actual return and the normal return over the event window.

The abnormal return is

$$AR_{it} = R_{it} - \hat{R}_{it} \tag{3}$$

Furthermore, by averaging the abnormal return on day $\tau$ across all $N$ companies, the average abnormal return ($AAR$) is calculated:

$$AAR_{\tau} = \frac{1}{N} \sum_{i=1}^{N} AR_{\tau} \tag{4}$$

Subsequently, the cumulative abnormal return ($CAR$) for parent company $i$ is the sum of the abnormal returns over the event window ($\tau_1 \ldots \tau_2$). The $CAR$ is

$$CAR_i(\tau_1,\tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{it} \tag{5}$$

The event window captures the day before the announcement day ($\tau_1 = -1$), the divestment announcement date or event day ($\tau = 0$) and the day after the announcement day ($\tau_2 = 1$). The reason for this is that the market may acquire information prior to the announcement on day -1 due to information leakage, and it may still react on day 1 after the stock market closes on the announcement day (MacKinlay, 1997).

Lastly, the cumulative average abnormal return ($CAAR$) is calculated as the sum of the $AAR$s over the event window ($\tau_1 \ldots \tau_2$):

$$CAAR(\tau_1,\tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AAR_{\tau} \tag{6}$$

To test whether the cumulative average cumulative abnormal ($CAAR$) is statistically significantly higher than 0 ($H1_{\alpha}$: $CAAR > 0$), I compute the following parametric test statistic $t$ according to Brown & Warner (1980, 1985):

$$t_{CAAR} = \frac{CAAR(\tau_1,\tau_2)}{\left\{ \sum_{\tau=\tau_1}^{\tau_2} \left[ \frac{1}{N^2} \sum_{i=1}^{N} \sigma_{\varepsilon}^2 \right] \right\}^{\frac{1}{2}}} \qquad (7)$$

A normal distribution is assumed. Moreover, *H1* requires a one-tailed test. Therefore, $H1_0$ is rejected if $t_{CAAR} > 2.33$ at the 1% level of significance and $t_{CAAR} > 1.645$ at the 5% level of significance.

In contrast to the parametric *t*-test, the *Wilcoxon signed-rank test* is a non-parametric test. The test does not assume a normal distribution of the abnormal returns, but a symmetric distribution of the stock returns. Furthermore, the *Wilcoxon signed-rank test* evaluates the abnormal returns on each day of the event window, while the CAAR *t*-test is evaluated over the entire event window. Therefore, the *Wilcoxon signed-rank test* is performed to assess the robustness of the significance of the abnormal returns. The abnormal returns are considered as differences in this test. The corresponding *Z*-value on day $\tau$ is:

$$Z_{Wilcoxon,\tau} = \frac{W - N(N-1)/4}{\sqrt{\frac{N(N+1)(2N+1)}{24}}} \qquad (8)$$

Both the sign and the magnitude of the abnormal returns are considered when computing the *Z*-value (Brown & Warner, 1980). The hypotheses for the two-tailed *Wilcoxon signed-rank test* are:

$H_{0Wilcoxon}$: The median abnormal return is equal 0.

$H_{\alpha Wilcoxon}$: The median abnormal return is not equal to 0.

The corresponding *p*-value is calculated to determine the significance of the *Z*-value.

### 4.2 The effect of the Paris Agreement, proved oil and gas reserves and oil price on the stock market reaction to divestment announcements in the oil and gas industry

Furthermore, CAR regressions are estimated to examine the specific oil and gas hypotheses:

$$CAR(-1;+1) = \alpha + \beta_1 ParisAgreement + \beta_2 TotalProvedOilReserves + \beta_3 TotalProvedNaturalGasReserves + \beta_4 OilPrice + \beta_5 Log\_Size + \beta_6 Leverage + \beta_7 ROA + \beta_8 Log\_DealValue + \beta_9 Domestic + \varepsilon$$

[1A]

$$CAR(-1;+1) = \alpha + \beta_1 ParisAgreement + \beta_2 ProvedDevelopedOilReserves + \beta_3 ProvedDevelopedNaturalGasReserves + \beta_4 ProvedUndevelopedOilReserves + \beta_5 ProvedUndevelopedNaturalGasReserves + \beta_6 OilPrice + \beta_7 Log\_Size + \beta_8 Leverage + \beta_9 ROA + \beta_{10} Log\_DealValue + \beta_{11} Domestic + \varepsilon$$

[1B]

where

*CAR (-1;+1)* = the cumulative abnormal return, which is the sum of the abnormal return on the day before the official divestment announcement, the abnormal return on the day of the announcement and the abnormal return on the day after the announcement

*Paris Agreement* = a dummy variable, which is equal to 1 when the Paris Agreement is most likely to affect oil and gas companies' decisions, i.e., as of the year 2016, and equal to 0 before the year 2016

*Proved developed oil reserves* = the amount of proved developed oil reserves at the end of the year in thousands of barrels scaled by total assets

*Proved developed natural gas reserves* = the amount of proved developed natural gas reserves at the end of the year in millions of cubic feet scaled by total assets

*Proved undeveloped oil reserves* = total proved oil reserves minus proved developed oil reserves scaled by total assets

*Proved undeveloped natural gas reserves* = total proved natural gas reserves minus proved developed natural gas reserves scaled by total assets

*Total proved oil reserves* = the sum of the proved developed and proved undeveloped oil reserves in thousands of barrels scaled by total assets

*Total proved natural gas reserves* = the sum of the proved developed and proved undeveloped natural gas reserves in millions of cubic feet of natural gas scaled by total assets

*Oil price* = the West Texas Intermediate (WTI) crude oil price, which is the U.S. oil price benchmark and is measured in U.S. dollars per barrel

*Control variables*:

*Log Size* = the natural logarithm of the book value of total assets

*Leverage* = the amount of total debt relative to total assets

*Return on assets (ROA)* = the amount of operating income before depreciation divided by total assets

*Log Deal value* = the natural logarithm of the deal value (which is measured in millions of dollars)

*Domestic* = a dummy variable that takes the value of 1 if the divestment is domestic (i.e., both parent company and acquirer are based in the United States) and 0 if the divestment is international (i.e., the acquirer is not based in the United States)

$\varepsilon$ = error term.

As mentioned earlier, there is no consensus on which type of reserves investors mainly use to forecast future cash flows. Therefore, following Atanasova & Schwartz (2019), I use the total proved reserves first, and then I divide the reserves into proved developed reserves and proved undeveloped reserves.

Subsequently, alternative CAR regressions are estimated with an additional control variable that accounts for the method of payment used by the acquirer.

$$CAR(-1;+1) = \alpha + \beta_1 ParisAgreement + \beta_2 TotalProvedOilReserves + \beta_3 TotalProvedNaturalGasReserves + \beta_4 OilPrice + \beta_5 Log\_Size + \beta_6 Leverage + \beta_7 ROA + \beta_8 Log\_DealValue + \beta_9 Domestic + \beta_{10} Payment + \varepsilon \quad [2A]$$

$$CAR(-1;+1) = \alpha + \beta_1 ParisAgreement + \beta_2 ProvedDevelopedOilReserves + \beta_3 ProvedDevelopedNaturalGasReserves + \beta_4 ProvedUndevelopedOilReserves + \beta_5 ProvedUndevelopedNaturalGasReserves + \beta_6 OilPrice + \beta_7 Log\_Size + \beta_8 Leverage + \beta_9 ROA + \beta_{10} Log\_DealValue + \beta_{11} Domestic + \beta_{12} Payment + \varepsilon$$

[2B]

where

*Payment* = a categorical variable which accounts for the method to pay for the deal used by the acquirer. The variable takes a value of 0 if the method of payment is 100% cash, 1 if it is 100% stock, 2 if 100% other (i.e., total value minus cash and stock), 3 if it is a combination of cash and stock, 4 if it is a combination of stock and other, 5 if it is a combination of cash and other and 6 if the method is a combination of cash, stock, and other.

As there is no reason to assume that the residuals of the regressions are homoscedastic, all regressions are performed with robust standard errors to account for heteroskedasticity in the errors of the regressions (MacKinlay, 1997). Additionally, a *White test* is performed to check for heteroskedasticity:

$H_{0White}$: the error variances are all equal (homoskedasticity)
$H_{\alpha White}$: the error variances are not all equal (heteroskedasticity)

The corresponding *p*-value is calculated to assess the significance of $\chi^2$.

## 4.3 Robustness test: the Mean Adjusted Returns model

To test the robustness of the event study results from the market model, the mean adjusted returns model is estimated as an alternative normal returns model. The mean adjusted returns model assumes that the mean return of a stock is constant through time (MacKinlay, (1997); Brown & Warner (1980)). Hence, in contrast to the market model, no regression is estimated to assess stock performance, as the mean adjusted model assumes no relation between the stock return and market return.

According to the mean adjusted returns model, the *ex ante* expected return for a given security *i* is

$$\hat{E}(R_i) = K_i \quad (9)$$

As the mean return is assumed to be a constant through time, the predicted *ex post* return is equal to $K_i$. Hence, the mean adjusted abnormal return $\varepsilon_{it}$ is equal to the difference between the observed return, $R_{it}$, and predicted return

$$\varepsilon_{it} = R_{it} - K_i \tag{10}$$

The estimation window to calculate the predicted return of the mean adjusted returns model is equal to the estimation window of the market model in this study, that is 200 days (day -250 to day -50) prior to the divestment announcement date.

# Chapter 5 Results

## 5.1 Stock market reactions to the divestment announcement with the S&P MidCap 400

Table 14 presents the Cumulative Average Abnormal Return (CAAR) from the market model with the S&P MidCap 400 as the market benchmark.

**Table 14:** Event Study Results for the Cumulative Average Abnormal Return from the Market Model with the S&P MidCap 400

| **($\tau_1$;$\tau_2$)** | **CAAR** | ***t*** |
|---|---|---|
| (-1;+1) | 0.95% | 2.935*** |

*This table shows the Cumulative Average Abnormal Return (CAAR) from the Market Model for all divestments in the full sample; the test statistic t is calculated according to the standard Brown & Warner (1980,1985) event study t-test;*** p < 0.01 using a one-tailed test.*

The CAAR of the divestment announcements over the three-day event window is 0.95% and shows a *t*-value that is significant at the 1% level ($t > 2.33$). As the CAAR in Table 14 is positive, the results suggest that the divestment announcement has a positive impact on the distribution of returns of the parent firm's stock. The magnitude of the CAAR in this study is relatively smaller than the CAARs that are obtained in other studies. Generally, previous studies find a CAAR that is at least higher than 1 over event window (-1;+1). For instance, Teschner & Paul (2020) find a CAAR of 1.59% over event window (-1;+1) when they examine the impact of divestitures on shareholder wealth.

Furthermore, Table 15 presents the results of the *Wilcoxon signed-rank test* with the distribution of positive and negative abnormal returns (ARs) for each day $\tau$ in the event window.

**Table 15:** Wilcoxon Signed-rank test Results on the Abnormal Returns with the S&P MidCap 400

| **$\tau$** | **Positive ARs** | **Negative ARs** | ***Z*** | **Sig. (*p*)** |
|---|---|---|---|---|
| -1 | 167 | 133 | 1.773 | 0.076* |
| 0 | 159 | 141 | 2.163 | 0.030** |
| +1 | 136 | 164 | -0.741 | 0.459 |

*This table presents the results from the Wilcoxon signed-rank test on the Abnormal Returns (ARs) for all divestments in the full sample;* p < 0.10, ** p < 0.05.*

On the day before the divestment announcement ($\tau = -1$) and on the day of the divestment announcement ($\tau = 0$) there are more positive abnormal returns than negative abnormal returns. In contrast, on the day after the announcement the majority of the abnormal returns are negative. The *Z*-value on day $\tau = -1$ is statistically significant at the 10% level, which implies that shareholders experience positive abnormal returns on the parent company stock on the day before the announcement. Hence, this suggests the possibility of information leakage regarding a potential divestment before its official announcement. In addition, the *Z*-value on day $\tau = 0$ is statistically significant at the 5% level, which suggests a positive effect of the divestment announcement on the official announcement day of the divestment announcement. In contrast, the *Z*-value on $\tau = +1$ shows no significant *p*-value, which suggests that there are no abnormal returns on the day after the announcement. In conclusion, the median difference, i.e., the median abnormal return, differs significantly from 0 on the official divestment announcement date and the day before the announcement day ($H_{0Wilcoxon}$ is rejected on day $\tau = -1$ and $\tau = 0$). This suggests that the divestment announcement is likely to have an impact on the distribution of returns of the parent company's stock.

The *Wilcoxon signed-rank test* results complement the conclusion from the CAAR *t*-test, as they add that the divestment announcement most likely impacts the parent company's stock price on the day before the official announcement and the day of the announcement. This confirms the finding in the majority of the event studies on divestment announcements in Table 1 that the divestment announcement positively affects the stock price of the parent company. Hence, $H1_0$, which states that the divestment announcement has no impact on the distribution of returns of the parent firm's stock, can be rejected.

### 5.2 The effect of the Paris Agreement, proved oil and gas reserves and oil price on the stock market reaction to divestment announcements

Table 16 presents the estimation results from the multiple linear regressions with dependent variable CAR (-1;+1) from the market model with the S&P MidCap 400.

**Table 16:** Multiple Linear Regression Results for the Effect on the Cumulative Abnormal Return from the Market Model with the S&P MidCap 400

| | CAR (-1;+1) | | | |
|---|---|---|---|---|
| | [1A] | [1B] | [2A] | [2B] |
| **Paris Agreement** | 0.001<br>(0.008) | 0.003<br>(0.007) | -0.0007<br>(0.011) | 0.001<br>(0.011) |
| **Total proved oil reserves** | 0.000<br>(0.000) | | 0.000**<br>(0.000) | |
| **Total proved natural gas reserves** | 0.000<br>(0.000) | | 0.000<br>(0.000) | |
| **Proved developed oil reserves** | | 0.000<br>(0.000) | | 0.001**<br>(0.000) |
| **Proved developed** | | 0.000<br>(0.000) | | 0.000<br>(0.000) |

| | | | | |
|---|---|---|---|---|
| **natural gas reserves** | | | | |
| **Proved undeveloped oil reserves** | | -0.0003<br>(0.000) | | 0.000<br>(0.000) |
| **Proved undeveloped natural gas reserves** | | 0.000<br>(0.000) | | 0.000<br>(0.000) |
| **Oil price** | -0.0002<br>(0.000) | -0.0001<br>(0.000) | -0.00003<br>(0.000) | 0.000<br>(0.000) |
| **Log Size** | -0.0002<br>(0.002) | -0.001<br>(0.002) | 0.002<br>(0.005) | 0.001<br>(0.004) |
| **Leverage** | 0.041*<br>(0.031) | 0.040*<br>(0.031) | 0.070**<br>(0.040) | 0.070**<br>(0.040) |
| **ROA** | -0.047*<br>(0.030) | -0.043*<br>(0.029) | -0.074**<br>(0.032) | -0.070**<br>(0.040) |
| **Log Deal value** | 0.002<br>(0.002) | 0.002<br>(0.002) | 0.003<br>(0.003) | 0.003<br>(0.003) |
| **Domestic** | -0.001<br>(0.006) | -0.0002<br>(0.005) | -0.002<br>(0.009) | -0.001<br>(0.009) |
| **Payment** | | | 0.001<br>(0.003) | 0.001<br>(0.003) |
| **Constant** | 0.000<br>(0.036) | 0.000<br>(0.036) | -0.060<br>(0.068) | -0.060<br>(0.068) |
| **Observations (N)** | 300 | 300 | 162 | 162 |
| **R-squared** | 0.145 | 0.150 | 0.240 | 0.244 |
| **Adjusted R-squared** | 0.118 | 0.118 | 0.190 | 0.183 |

*This table presents estimates from regression specifications [1A], [1B], [2A] and [2B] in §4.2; the estimation period is from 2004 to 2021; the dependent variable is the Cumulative Abnormal Return (CAR) (-1;+1), which is calculated with the Market model; regression specification [1A] and [2A] include total oil and gas reserves only, while [1B] and [2B] divide total reserves into developed and undeveloped reserves; in regression specification [2A] an[2B] the variable Payment is added, which reduces the sample size; heteroskedasticity robust standard errors are reported in parentheses;* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

Regression specification [1A] shows the effect of the Paris Agreement, total oil and gas reserves and oil price on the Cumulative Abnormal Return (-1;+1) for the full sample. The Paris Agreement and total reserves show a small positive association with the cumulative abnormal return, however the associations are not statistically significant. The positive coefficient of the total oil reserves is in line with the sign of the coefficient in Atanasova & Schwartz (2019). However, their study shows a statistically significant and economically large coefficient. The oil price shows a small statistically non-significant negative association with the cumulative abnormal return. This implies that the higher the oil price, the lower the cumulative abnormal returns from a divestment announcement. Related to this, Atanasova & Schwartz (2019) find a large positive significant effect of the oil price on firm value. The negative (statistically non-significant) association of the oil price with the cumulative abnormal return in regression [1A] could therefore imply that investors consider a sell-off as detrimental to firm value, when the oil price is high. In contrast, the coefficients of control variables leverage ($p$ = 0.090*) and

ROA ($p = 0.058^*$) are statistically significant at the 10% level. A higher leverage ratio is associated with a higher cumulative abnormal return, holding all other variables constant. This is in line with the case of shareholders benefiting from a sell-off when the firm is in financial distress, which is visible in a high leverage ratio. So, in terms of the trade-off theory of capital structure, excess debt in the firm lowered the value of the firm due to the costs of financial distress before the divestment took place. The proceeds of the divestment could be used to reduce leverage, which brings the firm closer to the optimal amount of debt that maximizes firm value. Hence, reduction of leverage leads to an increased firm value. On the contrary, the ROA has a negative association with the cumulative abnormal return, holding all other variables constant. In line with this, Atanasova & Schwartz (2019) find a negative relation between profitability and firm value, which suggests that a highly profitable firm might be in a mature phase with limited growth opportunities.

Regression specification [1B] divides total proved reserves into proved developed reserves and proved undeveloped reserves. The magnitude of the coefficients of the Paris Agreement and oil price changes slightly, however the signs remain the same and the coefficients remain statistically non-significant. None of the developed or undeveloped reserves has a statistically significant coefficient.

Regression specification [2A] adds the method of payment to the regression and considers total proved reserves. The sample size reduces from 300 to 162 divestment announcements, due to missing data for the payment variable. Remarkably, the sign of the association of the Paris Agreement with the cumulative abnormal return changes to negative, although it remains statistically non-significant. Furthermore, the coefficient of the oil price remains negative and non-significant. However, in contrast to the regression specifications without the method of payment variable, the total proved oil reserves show a small statistically significant positive effect of 0.04% on the cumulative abnormal return at the 5% level, holding all other variables constant ($p = 0.013^{**}$). The coefficient of total proved gas reserves shows no statistical significance, which supports the assumption of Misund & Osmundsen (2017) that investors might place different values on gas versus oil reserves. The coefficient of the method of payment is positive, which implies that sell-offs that are fully paid by cash show a slightly higher cumulative abnormal return compared to sell-offs that are paid by stock, another method of payment, or a combination of methods. This is in line with the possibility of the parent company to use the cash proceeds to invest in growth opportunities or to pay off debt, which would be valued positively by the market. However, the coefficient is not statistically significant.

Lastly, regression specification [2B] includes the method of payment for the sell-off and splits the total reserves into developed and undeveloped reserves. The sign of the coefficient of the Paris Agreement changes back to positive as in regression specifications [1A] and [1B], and remains statistically non-significant. In contrast, the coefficient of the oil price shows a statistically non-significant positive value.

Furthermore, the results suggest that the slight positive effect of the total proved oil reserves in regression specification [2A] is due to the positive effect of proved developed oil reserves on the cumulative abnormal return. The proved developed oil reserves show a small statistically significant positive effect of 0.06% on the CAR at the 5% level, holding all other variables constant ($p = 0.020^{**}$). Related to this, Misund & Osmundsen (2017) conclude that proved developed reserves are the main type of reserves used by investors to forecast firm value. None of the proved undeveloped reserves in regressions [1A] – [2B] shows a statistically significant coefficient. Therefore, the results in this study do not provide evidence for an association between undeveloped reserves and stock performance, which supports the conclusion in Misund & Osmundsen (2017). The coefficient of the method of payment remains similar. Lastly, leverage and ROA remain statistically significant in both regression specification [2A] and [2B].

Overall, across all four regressions the coefficient of the Paris Agreement shows no statistical significance. Hence, $H2_0$, which states that the implementation of the Paris Agreement has no effect on the abnormal returns of the parent company from a divestment announcement, cannot be rejected. Furthermore, total proved oil reserves and proved developed oil reserves show statistically significant coefficients in regressions [2A] and [2B], respectively. Thus, $H3_0$, which states that the amount of proved reserves a parent company has, does not affect the abnormal returns of the parent company from a divestment announcement, can be rejected. Importantly the significance of these reserves is only obtained when the variable that accounts for the method of payment is added to the regression, which reduces the sample size. Moreover, the coefficient of the oil price shows no statistical significance across the regressions. Therefore, there is no evidence that the oil price affects the cumulative abnormal return of the parent company. Hence, $H4_0$, which states that the oil price has no effect on the incentive of oil and gas firms to divest, cannot be rejected.

In addition, the results from the *White test* for heteroskedasticity in Table C (Appendix C) confirm the use of heteroskedasticity robust standard errors, as all regressions show statistically significant $\chi^2$ values at the 1% level of significance ($p = 0.000^{***}$). $H_{0White}$ is rejected.

## 5.3 Robustness test: the Mean Adjusted Returns model

### 5.3.1 Robustness test with the mean adjusted returns model: the stock market reaction to the divestment announcements

Table 17 presents the Cumulative Average Abnormal Return (CAAR) from the mean adjusted returns model to test the robustness of the results from the market model.

**Table 17:** Event Study Results for the Cumulative Average Abnormal Return from the Mean Adjusted Returns Model

| **($\tau_1$;$\tau_2$)** | **CAAR** | ***t*** |
|---|---|---|
| (-1;+1) | 0.85% | 2.427*** |

*This table shows the Cumulative Average Abnormal Return (CAAR) from the Mean Adjusted Returns model for all divestments in the full sample; the test statistic t is calculated according to the standard Brown & Warner (1980, 1985) event study t-test; *** p < 0.01 using a one-tailed test.*

The CAAR of the divestment announcements over the three-day event window is 0.85%, which is 0.10% lower than the CAAR from the market model. As in the market model, the mean adjusted returns model CAAR's *t*-value is significant at the 1% level ($t > 2.33$). As the CAAR is positive, the same conclusion as from the market model applies, which states that the divestment announcement has a positive impact on the distribution of returns of the parent firm's stock.

Furthermore, Table 18 reports the results from the *Wilcoxon signed-rank test* on the abnormal returns (ARs) from the mean adjusted returns model.

**Table 18:** Wilcoxon Signed-rank test Results on the Abnormal Returns from the Mean Adjusted Returns Model

| **$\tau$** | **Positive ARs** | **Negative ARs** | ***Z*** | **Sig. (*p*)** |
|---|---|---|---|---|
| -1 | 155 | 145 | 2.154 | 0.031** |
| 0 | 159 | 141 | 1.240 | 0.216 |
| +1 | 132 | 168 | -1.238 | 0.216 |

*This table presents the results from the Wilcoxon signed-rank test on the Abnormal Returns (ARs) for all divestments in the full sample;** p < 0.05.*

Similar to the abnormal returns from the market model, the majority of the abnormal returns from the mean adjusted returns model is positive on the day before the divestment announcement ($\tau = -1$) and on the day of the official divestment announcement ($\tau = 0$). In contrast, there are more negative than positive abnormal returns on the day after the announcement ($\tau = +1$), as in the market model. However, as opposed to the market model, the *Z*-value on day $\tau = -1$ is the only significant statistic in the model. The *Z*-value on day $\tau = -1$ is significant at the 5% level, which implies that shareholders only experience abnormal returns on the day before the official divestment announcement ($H_{0Wilcoxon}$ is rejected on $\tau = -1$). Again, this suggests pre-announcement information leakage on the market. Hence, the mean adjusted returns model suggests that the divestment announcement most likely affects the distribution of the parent company's stock on the day before the official announcement. However, the results from the market model suggest that the divestment announcement also affects the distribution of the parent company's stock on the official announcement day and not only on the day before.

Nevertheless, the conclusion regarding the overall stock market reaction to divestment announcements does not change with the use of the mean adjusted returns model compared tot the use of the market model. Thus, $H1_0$, which states that the divestment announcement has no impact on the distribution of returns of the parent company's stock, can be rejected.

### 5.3.2 Robustness test with the Mean Adjusted Returns model: the effect of the Paris Agreement, proved oil and gas reserves, and oil price on the stock market reaction to divestment announcements

Table 19 presents the estimation results from the multiple linear regressions with dependent variable CAR (-1;+1) from the mean adjusted returns model.

**Table 19:** Multiple Linear Regression Results for the Effect on the Cumulative Abnormal Return from the Mean Adjusted Returns Model

| | CAR (-1;+1) | | | |
|---|---|---|---|---|
| | [1A] | [1B] | [2A] | [2B] |
| **Paris Agreement** | 0.005<br>(0.008) | 0.007<br>(0.007) | 0.000<br>(0.011) | 0.002<br>(0.011) |
| **Total proved oil reserves** | 0.000<br>(0.000) | | 0.000**<br>(0.000) | |
| **Total proved natural gas reserves** | 0.000*<br>(0.000) | | 0.000<br>(0.000) | |
| **Proved developed oil reserves** | | 0.000<br>(0.000) | | 0.001**<br>(0.000) |
| **Proved developed natural gas reserves** | | 0.000<br>(0.000) | | 0.000<br>(0.000) |
| **Proved undeveloped oil reserves** | | -0.0003<br>(0.000) | | 0.000<br>(0.000) |
| **Proved undeveloped natural gas reserves** | | 0.000<br>(0.000) | | 0.000<br>(0.000) |
| **Oil price** | -0.0002*<br>(0.000) | -0.0002<br>(0.000) | -0.0002<br>(0.000) | -0.0001<br>(0.000) |
| **Log Size** | 0.000<br>(0.003) | -0.000<br>(0.002) | 0.002<br>(0.005) | 0.002<br>(0.005) |
| **Leverage** | 0.037<br>(0.031) | 0.036<br>(0.032) | 0.067**<br>(0.040) | 0.066*<br>(0.041) |
| **ROA** | -0.059**<br>(0.030) | -0.055**<br>(0.029) | -0.085***<br>(0.034) | -0.082***<br>(0.033) |
| **Log Deal value** | 0.001<br>(0.002) | 0.002<br>(0.002) | 0.003<br>(0.003) | 0.003<br>(0.003) |
| **Domestic** | -0.004<br>(0.006) | -0.003<br>(0.006) | -0.008<br>(0.010) | -0.007<br>(0.010) |
| **Payment** | | | 0.001<br>(0.003) | 0.001<br>(0.003) |
| **Constant** | 0.000<br>(0.036) | 0.000<br>(0.036) | -0.045<br>(0.071) | -0.045<br>(0.071) |

| | | | | |
|---|---|---|---|---|
| **Observations (N)** | 300 | 300 | 162 | 162 |
| **R-squared** | 0.171 | 0.175 | 0.265 | 0.267 |
| **Adjusted R-squared** | 0.145 | 0.143 | 0.216 | 0.208 |

*This table presents estimates from regression specification [1A], [1B], [2A] and [2B] in §4.2; the estimation period is from 2004 to 2021; the dependent variable is the Cumulative Abnormal Return (CAR) (-1;+1), which is calculated with the Mean Adjusted Returns model; regression specification [1A] and [2A] include total oil and gas reserves only, while [1B] and [2B] split total reserves into developed and undeveloped reserves; in regression specification [2A] and [2B] the variable Payment is added, which reduces the sample size; heteroskedasticity robust standard errors are reported in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01.*

Regression specification [1A] shows the effect of the Paris Agreement, total oil and gas reserves and oil price on the Cumulative Abnormal Return (-1;+1) for the full sample of 300 divestment announcements. Similar to the market model, the Paris Agreement shows a small statistically non-significant positive association with the cumulative abnormal return. In contrast to the association of the total proved natural gas reserves and CAR (-1;+1) in the market model, the total proved natural gas reserves show a small statistically significant positive effect of 0.003% on the cumulative abnormal return at the 10% level, holding all other variables constant ($p$ = 0.074*). Similar to the result with the market model, the oil price shows a small negative association with the CAR. However, with the mean adjusted returns model the association is statistically significant at the 10% level ($p$ = 0.077*). A one dollar increase in the oil price is associated with an decrease of the cumulative abnormal return (-1;+1) of 0.02%, holding all other variables constant. The negative coefficient of control variable ROA remains statistically significant at the 5% level ($p$ = 0.023**), while leverage is no longer statistically significant compared to the regression specifications with the market model.

Regression specification [1B] divides total proved reserves into proved developed reserves and proved undeveloped reserves. The coefficient of the Paris Agreement remains statistically non-significant, as with the market model. Similar to regression specification [1B] with the market model's CAR(-1;+1), none of the developed or undeveloped reserves has a statistically significant coefficient. As with the market model, the proved undeveloped oil reserves seem to have a small statistically non-significant association with the cumulative abnormal return. While the coefficient of the oil price remains similar in terms of its magnitude and sign, its statistical significance is no longer present when total reserves are split into developed and undeveloped reserves. The coefficient of ROA remains statistically significant and negative.

Regression specification [2A] adds the method of payment to the regression and considers total proved reserves. As with the market model, the sample size reduces to 162 divestment announcements. The coefficient of the Paris Agreement remains positive and statistically non-significant. Similar to the market model, when the payment variable is included, the total proved oil reserves show a small statistically significant positive effect of 0.04% on the cumulative abnormal return from the mean adjusted returns model at the 5% level, holding all other variables constant ($p = 0.011$**). The coefficient of the oil price remains statistically non-significant. The coefficient of the method of payment is not statistically significant.

In regression specification [2B] total reserves are split into proved developed and proved undeveloped reserves and the method of payment variable is added to the estimation. As with the market model, the small positive effect of total proved oil reserves on the cumulative abnormal return is due to the proved developed oil reserves. The proved developed oil reserves show a small statistically significant positive effect of 0.06% on the cumulative abnormal return at the 5% level ($p = 0.023$**). In contrast to regression [1A] and [1B], control variable leverage shows a statistically significant positive effect on the cumulative abnormal return at the 5% level in [2A] ($p = 0.050$**) and 10% level in [2B] ($p = 0.053$*). This is in line with the results for leverage in the regressions with the market model's CAR. The coefficient of control variable ROA remains statistically significant and negative across all four regression specifications. The coefficient of the method of payment is still not statistically significant.

Overall, the same conclusions with regard to the rejection of the hypotheses apply in the case of the mean adjusted returns model. In addition to the results with the market model's CAR as the dependent variable, total proved natural gas reserves show a positive statistically significant coefficient in regression [1A]. Therefore, there seems to be additional evidence for the rejection of $H3_0$, which states that the amount of proved reserves a parent company has, does not affect the abnormal return of the parent company from a divestment announcement. Although the oil price shows a statistically significant coefficient in regression [1A], the coefficient is not significant in the other regressions. Therefore, $H4_0$ can still not be rejected.

Again, the results from the *White test* for heteroskedasticity in Table C (Appendix C) confirm the use of heteroskedasticity robust standard errors, as all regressions show statistically significant $\chi^2$ values at the 1% level of significance ($p = 0.000$***). $H_{0White}$ is rejected.

## 5.4 Robustness test: the S&P 500 as an alternative market benchmark

### 5.4.1 Robustness test with the S&P 500: the stock market reaction to divestment announcements

Table 20 presents the Cumulative Average Abnormal Return (CAAR) from the market model with the S&P 500 Index to test the robustness of the results from the market model with the S&P MidCap 400 Index.

**Table 20:** Event Study Results for the Cumulative Average Abnormal Return from the Market Model with the S&P 500

| **($\tau_1$;$\tau_2$)** | **CAAR** | ***t*** |
|---|---|---|
| (-1;+1) | 1.01% | 3.105*** |

*This table shows the Cumulative Average Abnormal Return (CAAR) from the Market model for all divestments in the full sample; the test statistic t is calculated according to the standard Brown & Warner (1980, 1985) event study t-test; *** $p < 0.01$ using a one-tailed test.*

The CAAR of the divestment announcements over the three-day event window is 1.01%, which is 0.06% higher than the CAAR from the market model with the S&P MidCap 400. As in the market model with the S&P MidCap 400, the CAAR's *t*-value is significant at the 1% level ($t > 2.33$). Hence, the positive CAAR suggests that the divestment announcement has a positive impact on the distribution of returns of the parent firm's stock.

Table 21 presents the results from the *Wilcoxon signed-rank test* on the abnormal returns (ARs) from the market model with the S&P 500 Index.

**Table 21:** Wilcoxon Signed-rank test Results on the Abnormal Returns from the Market model with the S&P 500

| **τ** | **Positive ARs** | **Negative ARs** | ***Z*** | **Sig. (*p*)** |
|---|---|---|---|---|
| -1 | 167 | 133 | 2.165 | 0.030** |
| 0 | 168 | 132 | 2.484 | 0.013** |
| +1 | 136 | 164 | -0.733 | 0.464 |

*This table presents the results from the Wilcoxon signed-rank test on the Abnormal Returns (ARs) for all divestments in the full sample; ** $p < 0.05$.*

The distribution of positive and negative ARs is similar to the distribution of the ARs with the S&P MidCap 400. There are more positive abnormal returns that negative abnormal returns on the day before the announcement ($\tau$ = -1) and the day of the official announcement ($\tau$ = 0), while the opposite distribution is visible on the day after the announcement ($\tau$ = +1). Both the *Z*-values on day $\tau$ = -1 and day $\tau$ = 0 are statistically significant at the 5% level, which is similar to the results in the market model with the S&P400 MidCap. Hence, $H_{0Wilcoxon}$, which states that the median abnormal return is equal to 0, can be rejected on these days. Hence, the use of the S&P 500 as an alternative market index does not change the overall conclusion regarding the stock market reaction to divestment announcements. $H1_0$, which states that the divestment announcement has no impact on the distribution of returns of the parent company's stock, is rejected.

### 5.4.2 Robustness test with the S&P 500: the effect of the Paris Agreement, proved oil and gas reserves, and oil price on the stock market reaction to divestment announcements

Table 22 presents the estimation results from the multiple linear regressions with dependent variable CAR (-1;+1).

**Table 22:** Multiple Linear Regression Results for the Effect on the Cumulative Abnormal Return from the Market model with the S&P 500

| | CAR (-1;+1) | | | |
|---|---|---|---|---|
| | [1A] | [1B] | [2A] | [2B] |
| **Paris Agreement** | 0.002<br>(0.008) | 0.004<br>(0.007) | -0.002<br>(0.012) | -0.001<br>(0.011) |
| **Total proved oil reserves** | 0.000<br>(0.000) | | 0.000**<br>(0.000) | |
| **Total proved natural gas reserves** | 0.000<br>(0.000) | | 0.000<br>(0.000) | |
| **Proved developed oil reserves** | | 0.000<br>(0.000) | | 0.001**<br>(0.000) |
| **Proved developed natural gas reserves** | | 0.000<br>(0.000) | | 0.000<br>(0.000) |
| **Proved undeveloped oil reserves** | | -0.0003<br>(0.000) | | 0.000<br>(0.000) |
| **Proved undeveloped natural gas reserves** | | 0.000<br>(0.000) | | 0.000<br>(0.000) |
| **Oil price** | -0.0001<br>(0.000) | -0.0001<br>(0.000) | -0.00004<br>(0.000) | 0.000<br>(0.000) |
| **Log Size** | 0.000<br>(0.002) | -0.000<br>(0.002) | 0.002<br>(0.005) | 0.001<br>(0.005) |
| **Leverage** | 0.040*<br>(0.031) | 0.039<br>(0.031) | 0.068**<br>(0.040) | 0.068**<br>(0.040) |
| **ROA** | -0.050**<br>(0.029) | -0.045*<br>(0.028) | -0.074**<br>(0.034) | -0.070**<br>(0.033) |
| **Log Deal value** | 0.001<br>(0.002) | 0.001<br>(0.002) | 0.003<br>(0.003) | 0.003<br>(0.003) |
| **Domestic** | -0.003<br>(0.006) | -0.002<br>(0.005) | -0.004<br>(0.010) | -0.003<br>(0.010) |
| **Payment** | | | 0.000<br>(0.003) | 0.000<br>(0.003) |
| **Constant** | 0.000<br>(0.036) | 0.001<br>(0.036) | -0.051<br>(0.070) | -0.052<br>(0.071) |
| **Observations (N)** | 300 | 300 | 162 | 162 |
| **R-squared** | 0.148 | 0.154 | 0.229 | 0.232 |
| **Adjusted R-squared** | 0.121 | 0.122 | 0.178 | 0.170 |

*This table presents estimates from regression specifications [1A], [1B], [2A] and [2B] in §4.2; the estimation period is from 2004 to 2021; the dependent variable is the Cumulative Abnormal Return (CAR) (-1;+1, which is calculated with the Market model; regression specification [1A] and [2A] include total oil and gas reserves only, while [1B] and [2B] split total reserves into developed and undeveloped reserves; in regression specification [2A]* *and [2B] the variable Payment is added, which reduces the sample size; heteroskedasticity robust standard errors are reported in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

Regression specification [1A] shows the effect of the Paris Agreement, total oil and gas reserves and oil price on the Cumulative Abnormal Return (-1;+1) for the full sample. As for the CAR from the market model with the S&P MidCap 400, the Paris Agreement and total reserves show a small statistically non-significant positive association with the CAR. Similarly, the oil price shows a small statistically non-significant association with the CAR. As with the CAR from S&P Midcap 400 market model, the coefficient on control variable leverage is statistically significant and positive at the 10% level ($p$ = 0.095*). Again, control variable ROA is statistically significant and negative at the 5% level ($p$ = 0.044**). Regression specification [1B] divides total proved reserves into proved developed reserves and proved undeveloped reserves.

Regression specification [2A] adds the method of payment to the regression and considers total proved reserves. As with the S&P MidCap 400's CAR, the sign of the coefficient of the Paris Agreement changes to negative and remains statistically non-significant. As with the S&P MidCap 400, the total proved oil reserves show a small statistically significant positive effect of 0.04% on the CAR at the 5% level ($p$ = 0.013**). The coefficient of method of payment is not statistically significant.

Regression specification [2B] includes the method of payment and divides the total proved reserves into proved developed reserves and proved undeveloped reserves. Similar to the S&P MidCap 400 market model, the positive effect of total proved oil reserves seems to be generated by the proved developed oil reserves. The proved developed oil reserves show a statistically significant positive effect of 0.06% on the CAR at the 5% level ($p$ = 0.024**). The coefficient of leverage remains statistically significant and positive at the 5% level in both regression specification [2A] ($p$ = 0.045**) and [2B] ($p$ = 0.047**). The coefficient of the method of payment is still not significant.

Overall, the Paris Agreement and oil price show no statistically significant coefficients. Hence, as in the market model with the S&P MidCap 400, $H2_0$ and $H4_0$ can not be rejected. As in the market model with the S&P MidCap 400, total proved oil reserves and proved developed oil reserves show positive statistically significant coefficients in regressions [2A] and [2B], respectively. Thus, $H3_0$ can be rejected.

As for the earlier regressions, the results from the *White* test for heteroskedasticity in Table C (Appendix C) confirm the use of heteroskedasticity robust standard errors, as all regressions show statistically significant $\chi^2$ values at the 1% level of significance ($p$ = 0.000***). $H_{0White}$ is rejected.

# Chapter 6 Discussion and Conclusion

This paper aims to answer the following research question:

*To what extent do sell-offs in the fossil fuel industry create value for the parental firms' shareholders?*

Table 23 presents an overview of the hypotheses that are used to answer this question.

**Table 23:** Overview of the Hypotheses

| Number | $H_0$ | $H_\alpha$ | Conclusion |
|---|---|---|---|
| 1 | The divestment announcement has no impact on the distribution of returns of the parent firm's stock. | The divestment announcement has a positive impact on the distribution of returns of the parent firm's stock | $H1_0$ rejected |
| 2 | The implementation of the Paris Agreement has no effect on the abnormal returns of the parent company from a divestment announcement. | The implementation of the Paris Agreement positively affects the abnormal returns of the parent company from a divestment announcement. | $H2_0$ accepted |
| 3 | The amount of proved oil and gas reserves a parent company has, does not affect the abnormal returns of the parent company from a divestment announcement. | A higher amount of proved oil and gas reserves is associated with higher abnormal returns of the parent company from a divestment announcement. | $H3_0$ rejected |
| 4 | The oil price has no effect on the incentive of oil and gas firms to divest. | The higher the oil price, the less inclined oil and gas firms are to divest. | $H4_0$ accepted |

The results indicate that the stock of divesting oil and gas firms shows positive abnormal returns on the day of the official divestment announcement, in which the company states that it want to completely get rid of a certain business unit or division, and on the day before and after the announcement. This is in line with the majority of previous event studies that find a positive impact of divestment announcements on the performance of the parent company's stock.

In addition, total proved oil reserves show a small positive effect on the cumulative abnormal return on the parent company's stock that is measured from the day before the announcement up to and including the day after the announcement. When the method of payment and the division of total reserves into developed and undeveloped reserves is taken into account, the results suggest that this positive effect is due to the positive effect of proved developed oil reserves on the cumulative abnormal return around the divestment announcement day. These results are in line with Atanasova & Schwartz (2019) and

Misund & Osmundsen (2017), who analyse the effect of oil and gas reserves on firm value. A robustness test with the mean adjusted returns model provides additional evidence for the positive effect of the reserves on the abnormal returns from a divestment announcement, as total proved natural gas reserves show a small statistically significant effect on the cumulative abnormal return over the event window.

Hence, the answer to the research question is that sell-offs in the fossil fuel industry do create value for the parental firms' shareholders, as the announcements of firms to completely get rid of certain business units result in positive stock returns. In addition, there is evidence for higher abnormal returns if the parent company has higher levels of oil and gas reserves. Hence, when oil and gas companies announce to divest a polluting unit that most likely makes use of oil and gas reserves, they might send a credible signal to the market that it wants to get rid of these reserves that negatively affect firm value. In practice, this would imply that firms in the fossil fuel industry could benefit from the divestment of their polluting units and the investment in renewable energy projects.

However, there are several limitations of this study. Management might be forced to sell off an asset due to bankruptcy or climate regulations, or the divestment could be a strategic decision. However, the Thomson One M&A database does not specify the characteristics of the sell-offs. This means that the motive behind the divestment is unknown in this study. Besides that, it is unknown whether the divested unit is indeed a polluting unit that uses oil and gas reserves. Only the fact that the company sells 100% of its ownership of the unit to the acquiring company proxies for the sale of a polluting unit. However, in reality, the type of the asset that is being sold is important, as it influences the proceeds from the divestment. For instance, a profit-making asset will have more value than a loss-making asset. Related to this, the market will value clean assets and polluting assets differently.

In addition, the proceeds of the divestments depend on the financial condition of the firm before the divestment. If the parent company is in financial distress before the divestment, the acquirer of the asset will have a stronger negotiation position, which means that the cash proceeds from the sale will be lower. Therefore, further research could account for the financial condition of the firm before the divestment by adding lagged ROA to the regressions. Furthermore, the use of the proceeds is unknown. For instance, the firm could use the proceeds for investments in clean energy or to pay off debt. Hence, the use of the proceeds affects the long term financial condition of the firm. As the use of the proceeds becomes more visible over time, it is valuable to perform a long term analysis in addition to the short-term analysis in this study.

Moreover, the mean adjusted returns model in this study is performed with the same estimation window as the market model. However, an advantage of the mean adjusted returns model is the possibility to use a shorter estimation window than the market model, as the constant mean return is essentially an historical average. A shorter estimation window would avoid overlap with the events. So, further research could estimate the mean adjusted returns model with a shorter estimation window than the market model to obtain unbiased abnormal returns. Besides that, this study only captures stock market performance, while it would be valuable to compare stock market performance with accounting performance over time. An example of a relevant accounting performance measure is the Return on Equity (ROE).

Furthermore, the decision to divest is not necessarily a now-or-never decision, but an option to abandon. Therefore, further research could add real option theory to the analysis. Depending on the development of the oil price and market conditions, the firm considers whether it wants to sell a business unit or asset to limit downside losses or utilize the upward potential of the asset. This flexibility provides value. Hence, the market value of the firm does not only consist of the static value of its future cash flows as is assumed in this study. So, further research could look at the expanded Net Present Value of the firm, which captures the present value of future cash flows, the flexibility value in the firm and the strategic value.

Moreover, a small amount of divestment announcements in the sample are on dates that are relatively close together. This event-date clustering could lead to cross-sectional correlation, which influences the reliability of the reported test statistics in this study. Therefore, the inclusion of more comparative test statistics, such as the statistics from the *Adjusted Patell test* or *Adjusted Standardized Cross-section test* that account for cross-sectional correlation (Kolari & Pynnönen, 2010) could further determine the robustness of the event study results.

Lastly, the level of undeveloped oil and gas reserves affects firm value due to stranded asset risk. Therefore, further research could add firm fixed effects to the regressions to account for differences in the level of undeveloped oil and gas reserves between firms. Moreover, to obtain more reliable results on the effect of the Paris Agreement, the variable that captures the agreement could be interacted with other relevant variables, as it is merely a dummy variable. This would reveal non-linearities in the regressions.

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## APPENDIX A *Frequency distributions and normal density curves*

**Figure A.1**

*Frequency Distribution and Normal Density Curve of Size*

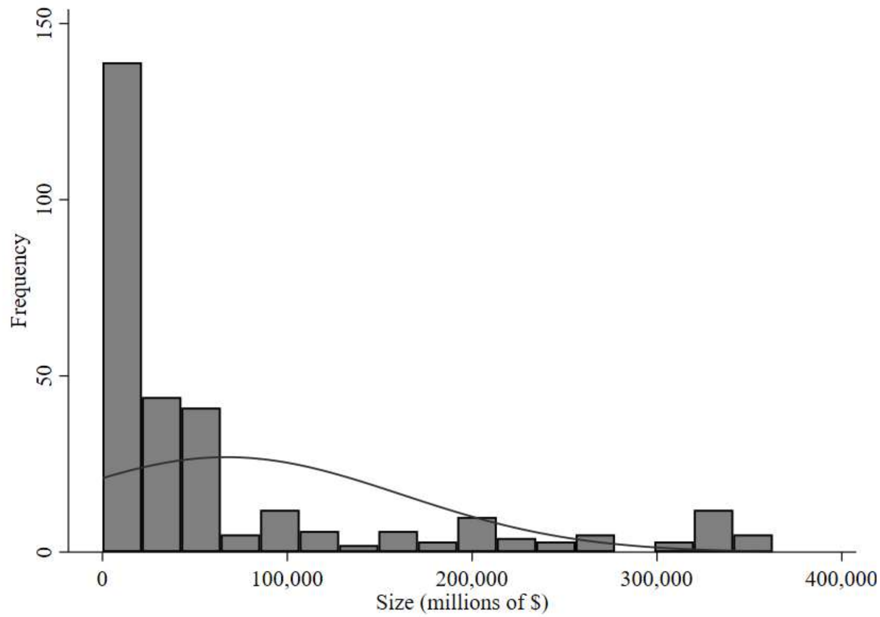



**Figure A.2**

*Frequency Distribution and Normal Density Curve of the Natural Logarithm of Size*

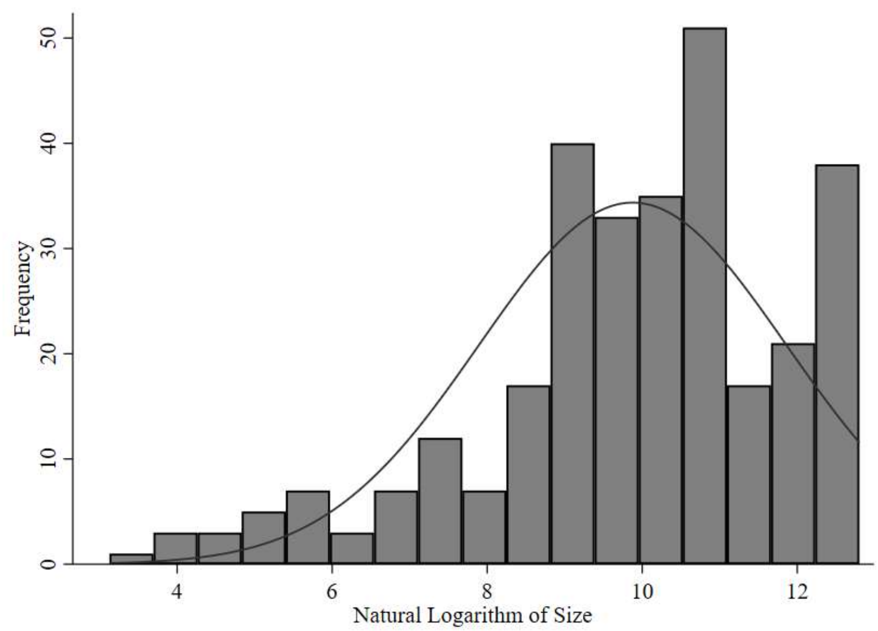


**Figure A.3**

*Frequency Distribution and Normal Density Curve of Deal Value*

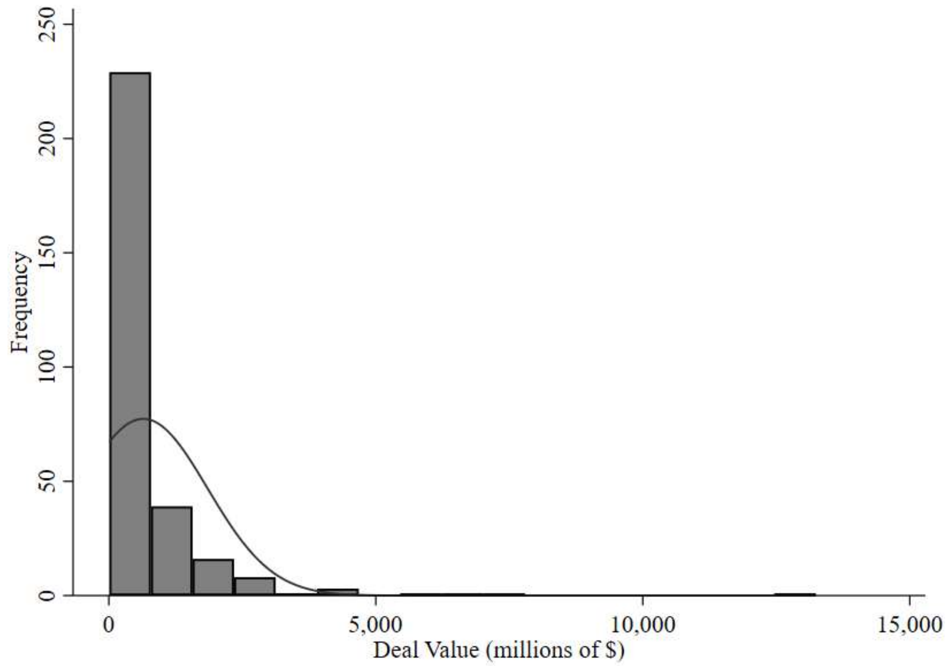



**Figure A.4**

*Frequency Distribution and Normal Density Curve of the Natural Logarithm of Deal Value*

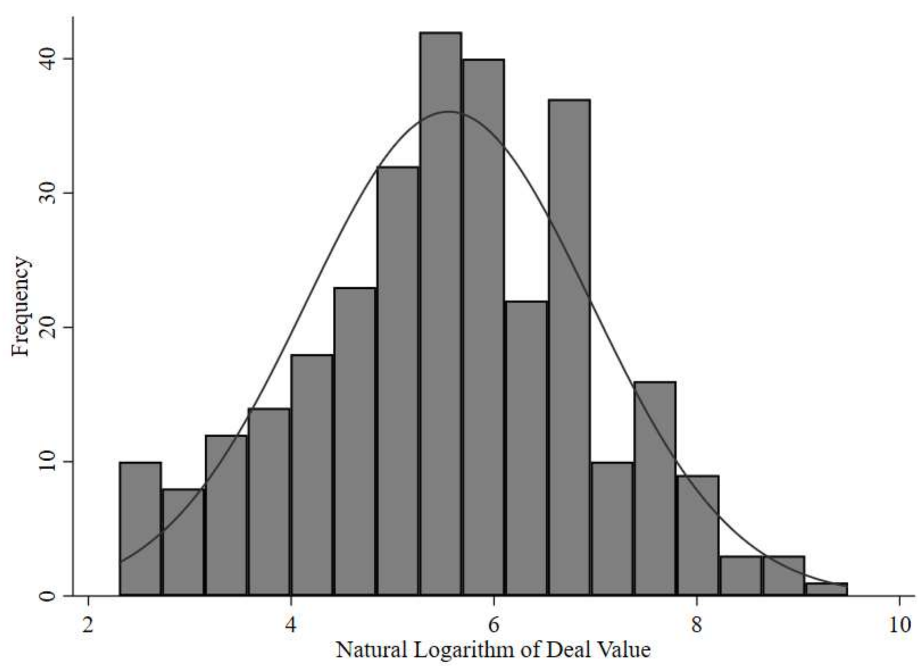


**Figure A.5**

*Frequency Distribution and Normal Density Curve of the Domestic Cumulative Abnormal Return (-1;+1)*

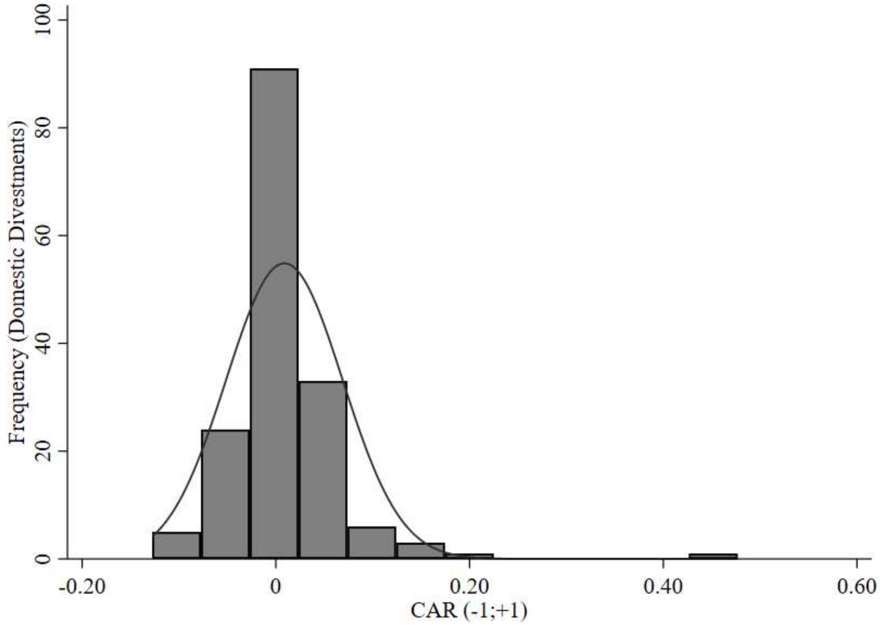



**Figure A.6**

*Frequency Distribution and Normal Density Curve of the International Cumulative Abnormal Return (-1;+1)*

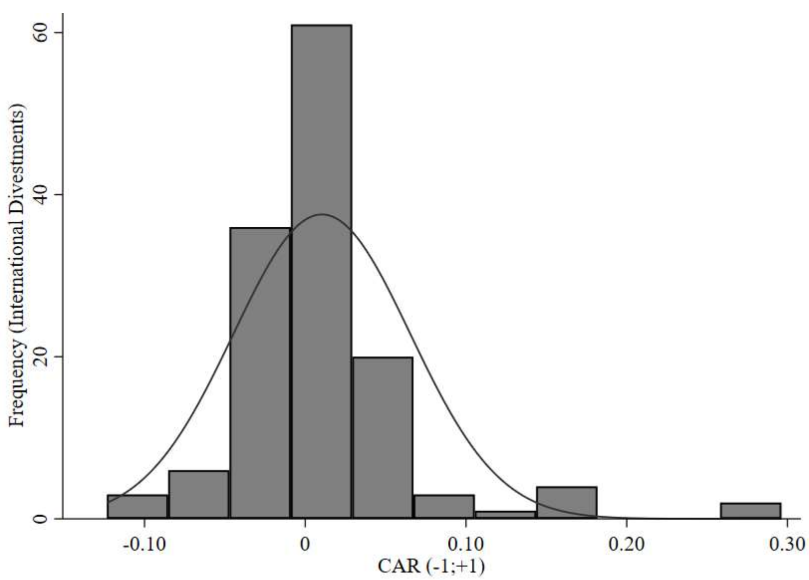


**Figure A.7**

*Frequency Distribution and Normal Density Curve of Market Capitalization*

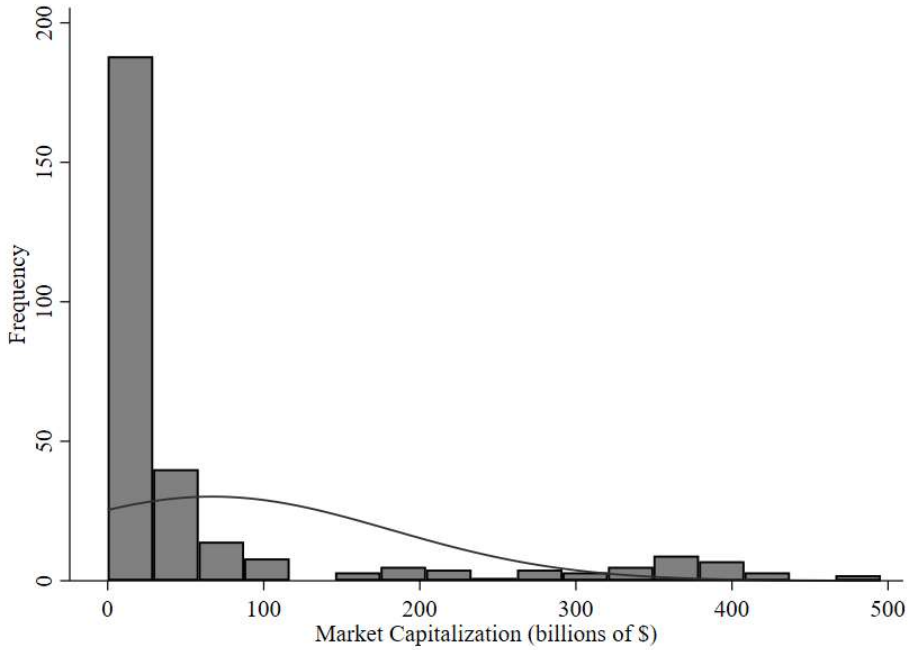
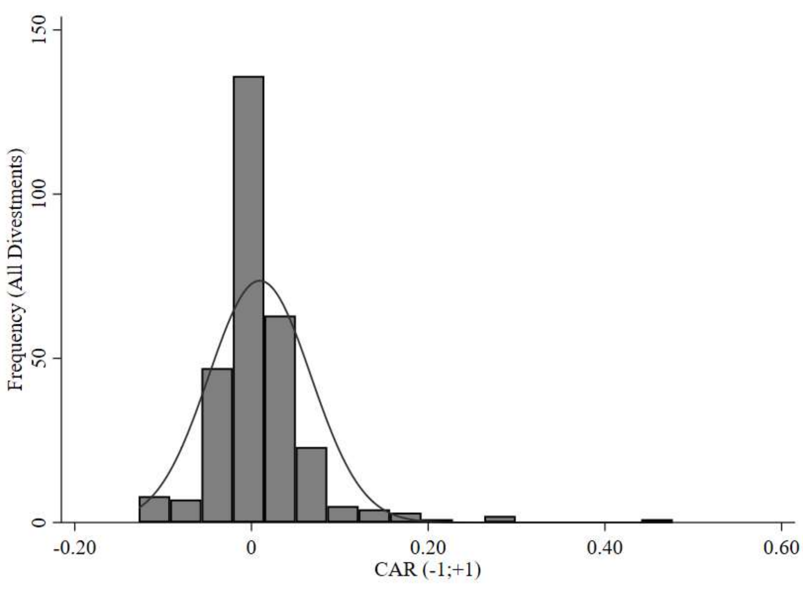



**Figure A.8**

*Frequency Distribution and Normal Density Curve of Cumulative Abnormal Return (-1;+1) of the Full Sample*



## APPENDIX B *Levene's Test for Equality of Variances between Domestic and International Divestments*

**Table B:** Levene's test Results for Equality of Variances between Domestic and International Divestments

| **Variable** | **Domestic divestments (N)** | **International divestments (N)** | ***F*** | **Sig. (*p*)** |
|---|---|---|---|---|
| **CAR (-1;+1)** | 164 | 136 | 0.331 | 0.566 |
| **Proved developed oil reserves** | 164 | 136 | 2.203 | 0.139 |
| **Proved developed natural gas reserves** | 164 | 136 | 0.596 | 0.441 |
| **Proved undeveloped oil reserves** | 164 | 136 | 0.006 | 0.938 |
| **Proved undeveloped natural gas reserves** | 164 | 136 | 5.976 | 0.015** |
| **Total proved oil reserves** | 164 | 136 | 0.490 | 0.485 |
| **Total proved natural gas reserves** | 164 | 136 | 2.773 | 0.097* |
| **Oil price (WTI)** | 164 | 136 | 0.328 | 0.567 |
| **Size** | 164 | 136 | 0.462 | 0.497 |
| **Leverage** | 164 | 136 | 3.476 | 0.063* |
| **ROA** | 164 | 136 | 2.801 | 0.095* |
| **Deal value** | 164 | 136 | 2.230 | 0.136 |
| **Market capitalization** | 163 | 133 | 0.219 | 0.640 |

*This table shows the results from the Levene's test for equality of variances between domestic and international divestments; the total number of observations (N), the test statistic centered at the median (F) and significance (Sig. (p)) are reported;* $p < 0.10$, ** $p < 0.05$.

# APPENDIX C *White Test for Heteroskedasticity*

**Table C:** White test Results for Heteroskedasticity

| Regression specification | Analysis | Normal Returns Model | Market Index | $\chi^2$ | Sig. (*p*) |
|---|---|---|---|---|---|
| **[1A]** | Main | Market model | S&P MidCap 400 | 158.57 | 0.000*** |
| **[1B]** | Main | Market model | S&P MidCap 400 | 192.87 | 0.000*** |
| **[2A]** | Main | Market model | S&P MidCap 400 | 128.60 | 0.000*** |
| **[2B]** | Main | Market model | S&P MidCap 400 | 148.78 | 0.000*** |
| **[1A]** | Robustness | Mean Adjusted Returns model | | 158.42 | 0.000*** |
| **[1B]** | Robustness | Mean Adjusted Returns model | | 194.90 | 0.000*** |
| **[2A]** | Robustness | Mean Adjusted Returns model | | 129.58 | 0.000*** |
| **[2B]** | Robustness | Mean Adjusted Returns model | | 147.99 | 0.000*** |
| **[1A]** | Robustness | Market model | S&P 500 | 153.63 | 0.000*** |
| **[1B]** | Robustness | Market model | S&P 500 | 190.13 | 0.000*** |
| **[2A]** | Robustness | Market model | S&P 500 | 129.50 | 0.000*** |
| **[2B]** | Robustness | Market model | S&P 500 | 147.24 | 0.000*** |

*This table presents the results from the White test for heteroskedasticity in the error terms of regression specifications [1A], [1B], [2A] and [2B] in §4.2;*** $p < 0.01$.*