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Can the *Renewable Energy Directive (2018/2001/EU)* explain the rise of M&A transactions in the renewable energy sector in Western Europe? A comparison with the United States

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Introduction

Background and hypotheses formulation

It is well known in finance that mergers and acquisitions activity occurs in clusters over time, called waves (see, e.g., Brealey et al., 2020). In addition, the literature has shown that M&A activity is correlated with increasing stock prices and P/E (Price Earnings) ratios[1] (Gugler et al., 2012). Therefore, many authors have proposed different explanations for the origin of these waves. Although there is no consensus on why they occur, the causes can be categorized into two groups: neoclassical and behavioral.

Two influential authors of the neoclassical theory are Mitchell and Mulherin (1996). They argue that waves of mergers and acquisitions in an industry are caused by technological, regulatory or economic shocks (Mitchell and Mulherin, 1996). Indeed, these shocks lead firms to engage in large-scale reallocations of their assets (Mitch and Mulherin, 1996). Harford (2005), who is a proponent of the neoclassical theory, goes a step further. He argues that these shocks alone are not enough to create M&A waves but that they must be accompanied by high capital liquidity (Harford, 2005).

Regarding the behavioral theory, Shleifer and Vishny (2003) argue that high stock market valuations lead overvalued bidders to acquire tangible assets of undervalued targets with their shares.

One sector that has undergone multiple regulatory, economic, and technological shocks over the last two decades is the energy sector. Indeed, in the current context of global warming, countries around the world have implemented regulations to reduce their greenhouse gas emissions. For instance, COP 21 of 2015 has forced its members' countries to reduce their

[1] Definition of P/E (Price Earnings) ratio: "relationship between a company's stock price and earnings per share (EPS). It is a popular ratio that gives investors a better sense of the value of the company. The P/E ratio shows the expectations of the market and is the price you must pay per unit of current earnings " (Corporate Finance Institute. (s.d.). *Price earnings ratio.* https://corporatefinanceinstitute.com/resources/knowledge/valuation/price-earnings-ratio/)

greenhouse gas emissions to keep global warming below two degree Celsius by 2100. Because energy is a sector that accounts for a lot of greenhouse gas emissions, more precisely 75% in Europe (European Commission, 2021), it cannot be neglected in the fight against global warming. This focus on the energy sector had led, in part, to an increased interest in renewable energy sources over the last two decades.

The European Union has adopted two major regulations concerning the renewable energy sector. First, the European Parliament issued the *Renewable Energy Directive (2009/28/EC)* in April 2009. This directive set targets for Europe's energy needs to come from renewable sources by 2020. In addition, it also included targets with regards to the percentage of transport fuels that had to come from renewable energy sources. In December 2018, a recast of this directive came into force, the *Renewable Energy Directive (2018/2001/EU)* (RED II). The latter set new targets for 2030 regarding energy needs and the percentage of transport fuels that must come from renewable sources.

Conversely, the United States followed an aggressive policy in favor of fossil fuels under President Donald Trump in the second half of the last decade, rather than promoting renewable energy. Indeed, in June 2017, Donald Trump announced his intention to withdraw from the Paris agreement (COP 21). In October 2017, he abolished Obama's Clean Power Plan. Finally, with the release of the latest version of the Affordable Clean Energy act in June 2019, he empowered states over decision-making on carbon dioxide emissions.

Around the implementation of RED II in December 2018, we notice an increase in the number of M&A deals in the renewable energy sector in Western Europe. The neoclassical explanation of merger waves states that policy shocks in an industry can lead to waves of M&A. Therefore, we formulate our first hypothesis, which studies the impact of the *Renewable Energy Directive (2018/2001/EU)* in Western Europe. Our first hypothesis is as follow:

$\mathbf{H_1}$: *The Renewable Energy Directive (2018/2001/EU) has increased the number of M&A in the renewable energy sector in Western Europe.*

At the same time, around the implementation of RED II, the number of M&A transactions in the United States decreased. Therefore, we choose to investigate the impact of RED II in the United States. As they have not undergone a significant regulatory shock, we

expect RED II to be insignificant. This would support our first hypothesis by emphasizing that the fluctuation in the number of deals in Western Europe is really due to RED II and not to other factors that we have not considered in our analysis. Therefore, our second hypothesis is as follow:

$\mathbf{H_2}$: The *U.S. renewable energy sector did not experience a rise in M&A deals as did Western Europe because it was not confronted, hence, not impacted by the regulatory shock RED II.*

Finally, we examine how capital liquidity affects the number of mergers and acquisitions to assess if we can confirm Harford's (2005) theory.

Workplan

This paper is divided into three parts: the literature review, the formulation of the hypotheses and the methodology, and the empirical analysis. Finally, we end this paper with a conclusion.

The first part is the literature review. It is organized into three sections and provides the theoretical background and knowledge necessary to formulate the hypothesis. First, it explains what mergers and acquisitions are, what the incentives to engage in such transactions are, what types of mergers and acquisitions exist, and finally, how these transactions are financed. Second, it explains the cyclical nature of mergers and acquisitions and summarizes the waves that have occurred. In addition, it provides the reader with historical data on the global and regional M&A markets. Third, it gives an overview of the regulations in the renewable energy sector in Western Europe and the United States.

The second part includes the formulation of the hypotheses, the explanation of the methodology, and information about our datasets. First, we formulate the hypotheses based on the knowledge we have acquired about mergers and acquisitions in the literature review. Then, we explain the methodology that we follow to test our hypotheses. The latter is based on Luo and Nazarov's (2019) study, which investigates whether the affordable care act provision is responsible for the recent wave of M&A in the U.S. health insurance industry. Therefore, we build two regression models, one for Western Europe and one for the United States. These take into account RED II in addition to variables from the neoclassical and behavioral frameworks to isolate the effect of the directive. Finally, we describe how our dataset was constructed.

In the last part, we empirically test our hypotheses with several regression models. First, we perform descriptive statistics on our datasets and remove outliers for some variables using the interquartile range. Second, we analyze the correlation between our independent variables to avoid multicollinearity. Third, we run regressions. Fourth, we remove outliers from the regression models using Cook's Distance. Fifth, we evaluate whether our models satisfy the different assumptions of multiple linear regression, and, if not, what this implies for our results. Finally, we discuss the results.

Part 1: Literature Review

1. Mergers and Acquisitions overview

1.1 Terminology

Mergers and acquisitions are corporate restructuring practices in which two or more companies pool assets or economic interests (Ceddaha, 2017). The two terms are often confused or used interchangeably (Sherman, 2018). As a result, they are often employed in conjunction with one another, under the name "Mergers & Acquisitions" (Sherman, 2018). Although the outcome of a merger or an acquisition is similar in that two (or more) companies with separate owners are now operating under the same roof to achieve strategic or financial goals, they are two different processes (Sherman, 2018). The Corporate Finance Institute provides us with the following definitions:

- **Merger**: "When two or more individual businesses consolidate to form a new enterprise […]. The merged entity usually takes on a new name, ownership, and management that is composed of employees from both companies. The decision to merge is always mutual since the merging companies combine their forces to seek certain benefits, even at the cost of diluting their individual power. There is usually no exchange of cash." (Corporate Finance Institute).

- **Acquisition**: "An acquisition entails one organization acquiring the business of another. The acquirer must purchase at least 51% of the target company's stock in order to gain absolute control over it. It usually occurs between two companies that are not equal in stature: a financially stronger entity generally acquires a smaller, relatively weaker one. It is not necessary for the decision to be a mutual one […]." (Corporate Finance Institute).

As these definitions suggest, there are some differences between the two processes, although they are pretty similar. Prior literature agrees on some elements that differentiate them, such as the legal structure of the firms after the process and their relative size to each other, and thus the balance of power between them.

First, the acquisition of a firm does not imply that the target ceases to exist and becomes part of the bidder's structure. Indeed, the target may continue to operate independently with almost no change in ownership (Kale et al., 2009). One example is Microsoft's acquisition of LinkedIn in 2016. Microsoft let LinkedIn operates as an independent company, and Jeff Weiner remains LinkedIn's CEO, which has been cited as a critical factor in the deal's success (Erlichman, 2019). Regarding mergers, Gaughan (2015), Sherman (2018), Hunter (2017) and many others agree that in a merger, two firms come together to form one.

Second, Hunter (2017) defines a merger as two firms of approximately equal size joining together to become one entity. Sahu and Agarwal (2017) share this definition and argue that the process is collaborative due to their similar size. The merger can even be considered identical to marriage since the board of directors of the merging firms must give their full consent for the process to happen (Griffin and Egbert, 1991; as cited in Sahu and Agarwal, 2017). Conversely, since the bidder in an acquisition is usually larger and financially more robust than the target, the acquisition can take the form of a hostile takeover without mutual consent (Sahu and Agarwal, 2017).

Nevertheless, the differences between these two terms remain ambiguous. For example, Mastracchio and Zunitech (2002) argue that in a merger, the participants are rarely of the same size and that sometimes it is simply an acquisition financed with common shares. The lack of clarity around these definitions often leads people to use them together (Sherman, 2018).

1.2 Motives

Since each merger or acquisition is unique, the motives behind these transactions are diverse. Indeed, there is no unanimous classification of the reasons why companies engage in M&A. Although categorizations may vary among authors, the same reasons are often cited (e.g., synergy). For example, a typology of the reasons behind an M&A process may be improved economic performance, personal benefits for managers, and increased market power (Brouthers et al., 1998; as cited in Hassan et al., 2018). Bhabra and Hossain (2018) offer a different classification: synergy, agency costs, and hubris. Calipha et al. (2011) share a similar typology. Therefore, I choose to detail the latter and distinguish between financial and operational synergies, as did Ravier (2017).

1.2.1 Synergy

Lexico defines synergy as "the interaction or cooperation of two or more organizations, substances, or other agents to produce a combined effect greater than the sum of their separate effects" (Lexico).

Ravier (2017) lists three main ways in which operational synergies create value. First, by reducing costs through economies of scale and scope. Second, by increasing revenue through new products and a new customer base. Finally, by influencing market price and reducing competition if the combined entity reaches a sufficient size. Ceddaha (2017) and Gaughan (2015) argue that revenue-enhancing synergies are more complex to achieve than cost-decreasing synergies. Indeed, McKinsey's report "*Where mergers go wrong"* estimates that 70% of mergers do not reach the expected revenue synergies (Christofferson et al., 2004).

Financial synergies are also a source of value creation. First, the structure of the combined entity can benefit from potential tax savings (Ravier, 2017). Second, the merger or acquisition can reduce the bidder's cost of capital since it diversifies its cash flows and makes the firm less risky for suppliers of capital (Gaughan, 2015). Finally, the firm can realize potential gains from purchasing well-managed but undervalued businesses (Ravier, 2017).

Regarding the performance of operational and financial synergies, studies are contradictory. Capron (1998), Dussauge (1974) and Mitchell (1982) argue that acquisitions driven by operational synergies are more efficient than those motivated by financial synergies (as cited in Ravier, 2017). The opposite is true for Chatterjee (1986), Ravenscraft & Scherer (1987) (as cited in Ravier, 2017). As for Ravier (2017), he demonstrates that acquisitions motivated by operational synergies are more likely to experience extreme buy-and-hold returns, both positive and negative. He explains this by the potential of operational synergies to bring together resources and capabilities to create more unique combinations than financial synergies. On the other hand, they are harder to value and implement (Ravier, 2017).

1.2.2 Agency costs

The agency costs theory emphasizes conflicts between managers and shareholders due to their diverging interests (Jensen and Meckling, 1976; Jensen, 1986). This theory suggests that managers engage in acquisitions not to increase overall shareholder wealth but out of self-interest (Yaghoubi, 2016). Agency costs may arise from how managers use the firm's free cash flows (FCF)[2]. Indeed, executives may be reluctant to distribute it to shareholders and prefer to engage in M&A transactions, even if they are overpaid (Tesolin, 2010). By making diversified acquisitions in various fields they are familiar with, they make themselves valuable to shareholders and harder to replace (Tesolin, 2010). Finally, Morck et al. (1990) provide empirical evidence that managerial self-interest is a source of value-destroying acquisitions.

1.2.3 Hubris

The Hubris hypothesis proposed by Roll (1986) argues that the overconfidence of executives leads them to make acquisitions, believing that their valuation is correct and that the market does not reflect the economic value of the firms brought together (Yaghoubi et al., 2016). Either these managers believe that the target is undervalued, which leads them to pay a too large takeover premium (Lajugie, 2017), or overestimate the synergies they will achieve (Malmendier and Tate, 2008; as cited in Lajugie, 2017). This cognitive bias is a source of non-value-creating deals (Yaghoubi et al., 2016).

1.3 Typologies

As with motives, there are different typologies of the types of mergers and acquisitions. A traditional classification used by many authors such as Ceddaha (2017), Tesolin (2010), and Zaho and Zhang (2020) is vertical, horizontal, and conglomerate.

[2] Definition of free cash flow (FCF): "Free cash flows are cash generated by the current operation of a business or real estate venture and are available to be distributed back to the owners/shareholders without affecting current levels of growth" (Brown, 1996, p. 174)

1.3.1 Horizontal

Horizontal mergers and acquisitions occur between competitors or potential competitors (Ceddaha, 2017). The purpose of such an operation is for a company to increase its market power and to achieve economies of scale (Ceddaha, 2017). Zhao and Zhang (2020) emphasize that one of the main advantages of horizontal M&A is the reduction of fixed production costs per unit, made possible by the increase in production. Intangible asset synergies, such as managerial and technical synergies, are also a desired outcome pursued in horizontal mergers and acquisitions (Zaho and Zhang, 2020).

1.3.2 Vertical

Vertical mergers and acquisitions occur between companies in the same sector but at different stages of the production process (Tesolin, 2010). These types of M&A are often carried out to internalize an upstream (i.e., a supplier) or downstream (i.e., a client, a transportation company) activity (Ceddaha, 2017). By integrating the industrial chain, the buyer will, among other things, reduce its transaction costs and improve its performance, assuming a solid operating and management capacity (Zaho and Zhang, 2020).

1.3.3 Conglomerate

Conglomerate mergers and acquisitions involve firms operating in different sectors (Ceddaha, 2017). One example is the acquisition of the newspaper “Les Echos” by LVMH, a leading French group in the luxury apparel industry. These mergers and acquisitions enable the acquirer to diversify risks by multiplying income sources and stabilizing cash flows (Zaho and Zhang, 2020). Nevertheless, conglomerate M&A are not without risk. Indeed, the bidder’s management often has weaker knowledge of the target industry than the one in which it operates, which can make the integration complicated (Zaho and Zhang, 2020).

Nowadays, non-family groups tend to refocus on a single business (so-called *pure players)* instead of carrying conglomerate mergers and acquisitions (Ceddaha, 2017). This trend

is caused by the desire of the financial markets to have more visibility on the strategy of these companies (Ceddaha, 2017).

1.4. Payment methods

There are three main payment methods to finance M&A transactions: cash, stock, and a mix of cash and stock. The choice of the medium of exchange is a crucial element of the deal since it has significant financial, accounting, and legal consequences. Furthermore, the payment method determines how the risks are shared between the parties (Ceddaha, 2017).

Regarding the returns of the different payment methods, it is first necessary to highlight that, in general, almost all benefits of mergers and acquisitions go to the target's shareholders and that the announcement returns are negligible or slightly negative for the acquirer (Ismail and Kreuse, 2010). Specifically, Asquith et al. (1987), Huang and Walkling (1987), Travlos (1987), Yook (2003), and Heron and Lie (2002) argue that acquisitions financed with stock result in negative returns to the bidder's shareholders around the announcement date (as cited in Rani et al., 2014). Conversely, they claim that cash-financed acquisitions lead to zero or insignificant positive returns. Finally, Ismail and Kreuse (2010) argue that cash offers lead to higher announcement returns for targets.

1.4.1 Cash-financed transactions

In a cash offer, the bidder acquires ownership of the target by purchasing its shares in exchange for cash (Ceddaha, 2017). A cash-financed acquisition has several advantages: simplicity, speed, no dilution of the bidder's shareholding, and no residual ties between the acquirer and the target after the transaction, except potential asset and liability guarantees or earnouts (Ceddaha, 2017).

The cash used to finance the deal may come from several sources and be used in different proportions. First, it may come from the company's retained earnings. Second, the firm can borrow money from a bank or a financial institution in the form of a loan. Third, the company can go to the financial markets to raise funds by issuing bonds or shares. If the

company is not listed on the stock exchange, it can raise funds by launching an initial public offering (IPO). If the company is already publicly traded, it can issue additional shares.

Espen Eckbo (2009) and Ceddaha (2017) argue that retained earnings and debt issued before the acquisition are the primary means of financing. In general, the acquirer only has access to a limited amount of cash unless it has been saving its free cash flow for a long time (Fischer, 2017). Therefore, the bidder usually does not have enough liquid assets to finance the deal only with its retained earnings and will have to use debt (Fischer, 2017).

In addition to bearing the usual risks associated with an external growth operation, a cash-financed acquisition also supports financial risks due to the issuance of debt, weakening the financial structure of the acquirer (Ceddaha, 2017). Ceddaha (2017) suggests that raising capital, either before or after the acquisition, is a way to mitigate these financial risks.

1.4.2 Stock-financed transactions

In a stock offer, the bidder uses its shares as the payment method to acquire the target's shares. Both companies still exist after the transaction, with the target being a subsidiary of the acquirer and the target's shareholders being shareholders of the bidder. This medium of exchange enables the bidder not to raise additional capital to finance the deal. In addition, financing an acquisition with stock allows the bidder to share the risk of not realizing the expected post-integration synergies with the target (Neelam et al., 2014). Moreover, it allows the latter to share the transaction risks due to information asymmetry, particularly when it is difficult to value the company accurately (i.e., an unlisted company) (Officer, Poulsen and Stegemoller, 2009; as cited in Feito-Ruiz et al., 2015). However, there is a dilution of the bidder's power since the target's shareholders are now shareholders of the bidder.

In a stock acquisition, unlike a cash acquisition, the value of the deal does not remain constant between announcement and closing due to potential changes in the acquirer's stock price (Neimeth, 2006). There are two main ways to determine the number of shares the acquirer has to issue to purchase the target's stock.

The first one is the fixed exchange ratio, which determines a fixed number of shares to be issued at closing. Bidders generally prefer this method, even if there is a risk of overpayment since it avoids more significant dilution if the bidder's stock price declines by closing (Neimeth, 2006).

The second method, which is more value-oriented and preferred by targets, is the floating exchange ratio (Neimeth, 2006). In this case, both parties agree to a nominal price per target's stock. The number of shares to be issued by the bidder depends on the closing price of its share. In this case, the risk for the bidder is that he might have to give more shares than expected, resulting in greater dilution.

In order to reduce value and dilution uncertainties, targets and bidders can agree on minimum (floor) and maximum (cap) parameters for the number of shares and value of the deal (Neimeth, 2006). A collar is a "process" that includes both a floor and a cap. It can be of two types: fixed value and fixed share.

In a fixed value collar, the parties agree on a price range for the buyer's stock within which the latter agrees to issue a constant dollar value of its shares for each target's share. Within this collar, the exchange ratio adjusts to the bidder's share price changes so that the value of the transaction is respected. If the bidder's share price goes above the cap or under the floor, the exchange ratio will be set at the cap or floor level, respectively.

In a fixed share collar, the parties negotiate a range of values for the bidder's share price for which the acquirer commits to deliver a fixed number of shares for each target's share. If the bidder's share price rises above the cap or falls under the floor, the exchange ratio will decrease or increase, respectively.

1.4.3 Mix of cash and stock

It is typical for mergers and acquisitions to be financed with a mix of cash and shares (Ceddaha, 2017). The proportion of cash and equity used to fund the deal will impact the financial risks incurred by the bidder and the dilution of its shareholder base (Ceddaha, 2017).

In terms of financial risk, the higher the proportion of cash used, the greater the debt and the higher the financial risk due to the weakening of the financial structure (Ceddaha, 2017). Conversely, stock financing increases equity rather than debt.

In terms of dilution of the bidder's shareholders, the higher the proportion of cash used, the less dilution and the less the target's shareholders benefit from the advantages generated by the acquisition (Ceddaha, 2017).

1.4.4 Determinants of payment method

Many factors influence the medium of exchange chosen to finance a merger or acquisition. Here we discuss some of the most important ones: Information asymmetry, managerial control, taxation, debt capacity, market credit risk and market credit condition, and free cash flow.

Information Asymmetry

Information asymmetry is the situation in which some participants have information that others do not. The latter is typical of M&A transactions (Ceddaha, 2017). Throughout the M&A process, targets reduce information asymmetry by disclosing more and more information (e.g., through due diligence) to the bidder (Ceddaha, 2017).

Hansen (1987) is one of the first authors to attempt to fill the lack of understanding regarding the means of payment in a merger or acquisition transaction. He develops a model centered on adverse selection using information asymmetry to explain the medium of exchange. In the case of double-sided asymmetric information, Hansen (1987) argues that the acquirer is more likely to offer stock when it is overvalued and cash when it is undervalued.

Brown and Ryngaert (1991) also develop a model in which the acquirer whose shares are fairly valued or overvalued chooses stock as a medium of exchange to avoid tax considerations. Conversely, if the bidder's shares are undervalued, he will select cash as the payment method, even though the price might be higher for tax reasons. One implication is that a bidder who uses stock as a medium of exchange reveals more negative information than when he chooses to use cash (Boone et al., 2014). Indeed, bidders who use shares to finance an

acquisition signal to the market that their shares are overvalued, leading to a decline in the price around the acquisition announcement date (Yaghoubi et al., 2016).

Regarding the target's managers, Feito-Ruiz et al. (2015) argue that they accept overvalued shares because they intend to leave the company in the short term or because the bidder will compensate them once the transaction is completed, either by keeping them in their position or by paying them a high compensation.

Managerial control

Depending on whether the bidder finances the deal with cash or equity, its shareholding will be affected differently. Indeed, the choice between cash and equity involves a trade-off between the bidder's loss of corporate control of the firm and the increased financial distress costs associated with debt issuance (Faccio and Masulis, 2005). Financing an acquisition or merger with shares thus influences the bidder's governance structure since stock issuance dilutes the power of the shareholders (Faccio and Masulis, 2005).

Amihud et al. (1990), based on the work of Harris and Raviv (1988) and Stulz's (1988), argue that the bidder's management will be reluctant to finance the deal with stock if they have a significant stake in the firm and if they value control.

Martin (1996) argues that the relationship between equity financing and managerial ownership is not linear. Indeed, he argues that at really low and high ownership levels, the bidder's management is less concerned about the dilution of power. Conversely, managers with medium ownership levels are more likely to be worried about the loss of control. More specifically, Martin (1996) argues that managers with 5% to 25% of ownership will be more reluctant to pursue stock acquisition due to the dilution of control.

Faccio and Masulis (2005) study the choice of payment method in European M&A, and also argue that bidders are more likely to choose cash as the medium of exchange when their controlling shareholders have an intermediate ownership level. However, Faccio and Masulis (2005) consider the middle level of ownership between 20% and 60% rather than 5% to 25%. Faccio and Masulis (2005) explain this difference because ownership is much more concentrated in Europe than in the United States.

Two of the first authors to study the influence of ownership of target's managers are Ghosh and Ruland (1998). They argue that target's managers who have a high level of ownership and who value influence prefer a stock-financed acquisition. One reason why they value influence in the combined entity is that they will be able to influence job retention (Ghosh and Ruland, 1998). Indeed, previous studies have shown that there is a significantly high turnover after acquisitions (Martin and McConnell, 1991; as cited in Ghosh and Ruland, 1998). By receiving shares and influencing the combined entity, the target's managers are more likely to retain their job (Ghosh and Ruland, 1998). Therefore, they will negotiate payment in shares and discourage payment in cash (Ghosh and Ruland, 1998). Overall, they argue that ownership of the target's managers outweighs ownership of the acquirer's managers in explaining the method of payment.

Faccio and Masulis (2005), also pioneers in the study of the influence of target ownership structure on the payment method, find contradictory results. They find that acquisitions are more likely to be financed in cash when target ownership is concentrated. The underlying rationale is that a high concentration of target ownership threatens the bidder's controlling block by diluting the shareholder base (Faccio and Masulis, 2005).

Chang et al. (2013) support the view of Faccio and Masulis (2005). They argue that cash-financed acquisitions are more likely to occur when the target has strong managerial ownership. Conversely, stock-financed acquisitions are inversely related to the target's managerial ownership (Chang, Mais and Sullivan, 2013). In addition, they argue that the payment method is independent of the target's managerial retention.

Taxation

Another often discussed and controversial determinant of the payment method is taxation. In a share-financed acquisition, capital gains taxes of the target's shareholders are deferred until the shares are sold (Wansley et al., 1983). Conversely, in cash-financed acquisitions, capital gains are taxed in the transaction year (Wansley et al., 1983). To compensate for the fact that the target's shareholders do not have the option of deferring taxation, the premium paid for cash-financed M&A are higher than for securities-financed M&A (Wansley et al., 1983). In addition, bidders are willing to pay a higher takeover premium because it leads to a greater goodwill and, therefore, higher tax deductions for goodwill amortization (Ayers et al., 2000).

Nevertheless, Ismail and Krause (2010), among other authors, found no evidence of a tax effect on M&A payment methods in their study of U.S. public company between 1985 and 2004. Conversely, authors such as Ayers et al. (2003) confirm the positive association between cash financing and the tax-induced acquisition premium. The impact of taxation on the method of payment in M&A transactions thus remains uncertain.

Debt capacity, market credit risk and market credit condition

Previous studies have provided evidence that cash-financed acquisitions are mainly financed by debt (Karampatsas et al., 2014). In addition, a firm's ability to incur debt is positively correlated with its tangible assets, asset diversification, and earnings growth, while it is negatively correlated with its asset volatility (Hovakimian et al., 2001; as cited in Faccio and Masulis, 2005).

Faccio and Masulis (2005) study the impact of a firm's collateral on its debt capacity and form of payment in an acquisition. They define a firm's collateral as "the ratio of property, plant, and equipment (PPE) to book value of total assets at the year-end prior to the bid" (Faccio and Masulis, 2005, p. 1350). They find that acquisitions financed with cash have the highest collateral (38%) compared to equity-financed and mixed deals (27% and 31%, respectively). Therefore, bidders with a high collateral ratio are more likely to use cash as the payment method (Faccio and Masulis, 2005). Indeed, bidders with significant tangible assets can borrow more from banks and capital markets (Faccio and Masulis, 2005).

Previous studies regarding the impact of the leverage ratio on the payment method arrive at contradictory results. Faccio and Masulis (2005) find a negative correlation between a firm's leverage ratio and the probability of using cash due to the bidder's concerns about increasing the likelihood of bankruptcy. Overall, Faccio and Masulis (2005) argue that a firm with a weakening financial position is more likely to use stock as a payment method. Furthermore, they argue that interlocking directorships facilitate bidder's access to debt financing, increasing the likelihood of cash as a payment method.

Conversely, Harford (2009) argues that there is a positive relationship between leverage and the use of cash to finance the deal. Furthermore, he claims that a bidder is unlikely to pay

a significant portion of a large acquisition in cash and that he will instead take on more debt when already overleveraged.

Credit Rating Agencies (CARs) also contribute significantly to the level of corporate indebtedness. Indeed, by assessing the creditworthiness of firms, CARs reduce information asymmetry and thus financial constraints (Whited, 1992, Gilchrist and Himmelberg 1995, Almeida et al., 2004, and Campello and Chen, 2010; as cited in Karampatsas et al., 2014). Karampatsas et al. (2014) find a positive relationship between the buyer's rating and the use of cash to finance the transaction. They explain this because a bidder with a high credit rating has a lower cost of debt and a higher demand for its securities, making it less hesitant to finance the transaction with cash since it will be less complicated for the firm to find cash for future investments.

Finally, Harford (2005) demonstrates a negative relationship between the interest rate spread, which he defines as the spread between the Federal Funds Rate and the average rate on commercial and industrial loans and cash-financed acquisitions. Indeed, the lower the spread, the lower the cost of capital and the higher the likelihood of using cash.

Pecking order and free cash flow

According to the pecking order theory of financing, managers follow the following hierarchy to finance an investment: internal funding, borrowing, and external equity (Myers, 1984). Indeed, firms generating large amounts of free cash flow are more likely to use cash as a payment method to finance the transaction (Jensen, 1986). In addition, Martin (1996) argues that firms with high cash flow or debt capacity are more likely to finance the deal with cash. Furthermore, he argues that the higher the bidder's cash reserves relative to the acquisition price, the lower the probability that the deal will be financed with stock.

Harford (1999) argues that the higher a firm's cash reserve, the greater the likelihood of the firm being a bidder. This result is consistent with agency costs and the underlying free cash flow hypothesis of Jensen and Meckling (1976) and Jensen (1986), which states that managers with large amounts of cash will invest in negative net present value (NPV) investments rather than distribute it to shareholders. Conversely, Gao (2015) comes to a different conclusion and

states that rich companies are less likely to become bidders than poor ones. Indeed, he argues that bidders have been more selective when undertaking acquisitions over the past two decades.

2. Mergers and acquisitions market

2.1 The cyclical nature of M&A activity

It is well established in the literature that M&A deals tend to occur in waves (Yaghoubi et al., 2016). In addition, it is also known that M&A activity is correlated with increasing stock prices and P/E (Price Earnings) ratios (Gugler et al., 2012). Therefore, two major theories attempt to explain the cyclical nature of M&A: neoclassical and behavioral.

In the neoclassical approach, economic, technological, and regulatory shocks trigger waves of mergers and acquisitions by requiring large-scale reallocations of assets (Mitchell and Mulherin, 1996). These shocks can take many forms, for example, deregulation, changes in input costs, and new technologies (Mitchell and Mulherin, 1996). These shocks induce or allow changes in the industry structure in which they occur (Mitchell and Mulherin, 1996). Firms in that industry can either respond internally or externally to these changes. Mitchell and Mulherin (1996) argue that the external way (i.e., mergers and acquisitions) is often the least costly. This leads M&A activity to cluster around narrow time periods, more specifically, within a two-year period (Mitchell and Mulherin, 1996). Harford (2005), who is also a supporter of the neoclassical theory, adds that these shocks alone are not enough to trigger waves. Indeed, he argues that there must be sufficient capital liquidity, and thus, low transaction costs for these shocks become waves.

In the behavioral approach, high stock market valuations lead managers whose shares are overvalued to exchange them for assets from undervalued targets (Shleifer and Vishny, 2003). However, while this theory can explain mergers through share swaps, it cannot explain cash-financed acquisitions (Harford, 2005).

Gugler et al. (2012) propose a more comprehensive set of theories explaining the determinants of M&A waves: the q-theory of mergers, the industry shocks theory, the managerial discretion theory, and the overvalued shares theory. The first two theories can be characterized as neoclassical, while the last two can be considered as behavioral.

2.1.1 The q-theory of mergers

The Q ratio, also known as Tobin's Q, is the ratio of the market value of a company's assets divided by the replacement cost of those assets (Hayes, 2020). A Tobin's Q ratio higher than one means that the company is overvalued, while a Tobin's Q ratio lower than one means that the company is undervalued.

According to the q-investment theory, a company's investment rate rises with its q (Jovanovic and Rousseau, 2002). Jovanovic and Rousseau (2008) extend this definition to the field of mergers and acquisitions. They argue that the existence of new general-purpose technology (GPT), such as the automobile in the 1920s, can lead to a wave of mergers. Indeed, this technological shock will increase the profitability of investments such as M&A and lead to an increase in Tobin's Q of many companies. This increase in Q will create a stock market boom and a merger wave (Gugler et al., 2012). In addition, high-Q firms are more likely to buy low-Q firms during this wave (Andrade et al., 2001; as cited in Jovanovic and Rousseau, 2002).

2.1.2 The industry shocks theory

Harford (2005) proposes a neoclassical explanation of merger waves. According to him, multiple shocks (economic, technological, and regulatory) lead to large-scale reallocations of assets. These large-scale reallocations of assets, however, require sufficient capital liquidity for these shocks to become waves. The industry shocks theory, therefore, asserts that a merger wave will only occur if there is an economic motivation behind the mergers and acquisitions and if there is high capital liquidity, and thus, low transaction costs, allowing a large volume of transactions to take place (Harford, 2005).

While the q-theory relies on the existence of a common underlying technological shock, the industry shocks theory implies the existence of multiple economic, technological, and regulatory shocks (Gugler et al., 2012). Nonetheless, the two theories are similar in that merger waves are the consequences of *real* shocks that increase the profitability of mergers (Gugler et al., 2012).

2.1.3 The managerial discretion theory

According to the managerial discretion theory, managers derive utility from the growth of their company, either because their income is tied to it or because they derive a "psychic income" from managing a larger firm (Gugler et al., 2012).

During stock market bubbles, investors are convinced that certain types of mergers (e.g., conglomerates in the 1960s, media companies in the 1990s) create synergies (Gugler et al., 2012). These types of mergers are therefore well received by the market, allowing executives to freely engage in these transactions without fear of their company's share price falling dramatically (Gugler et al., 2012). Thus, management undertakes mergers that would have resulted in a sharp decline in the acquirer's share price if it were not for the market euphoria (Gugler et al., 2012).

In summary, according to the managerial discretion theory, M&A waves occur during bull markets. Market optimism enables managers seeking growth to undertake more wealth-destroying transactions than they normally would under average market conditions (Gugler et al., 2012).

2.1.4 The overvalued shares theory

Shleifer and Vishny (2003) argue that markets are inefficient and that they can misprice the target, the bidder, and their combination. Conversely, they argue that managers understand these incorrect evaluations and take advantage of them. This hypothesis is somewhat contradictory to Roll's hubris theory, according to which managers are not rational, but the market is.

These managers exchange their overvalued stock for assets of undervalued firms (Shleifer and Vishny, 2003). Since these managers are assumed to have a long-term horizon, acquiring assets with their overvalued shares enable them to increase the long-term value of their equity (Shleifer and Vishny, 2003). In contrast, target managers are assumed to have a short-term horizon. According to Shleifer and Vishny (2003), target's managers accept these overvalued shares because of their short-term horizon, which allows them to cash in on favorable terms.

Rhodes-Kropf and Viswanathan (2004) take a different view of why target's management accepts overvalued shares (Gugler et al., 2012). They argue that the latter struggles knowing whether the shares are overvalued because of market optimism or because the price includes the expected synergies from the merger.

2.2 Merger waves historic

As we discussed, M&A activity tends to cluster over time. The mergers and acquisitions market has experienced six major waves since the late 1890s, primarily in the United States (Yaghoubi et al., 2016).

- 1897-1904: The first wave was triggered by massive technological changes due to the electrification of the industry. It impacted all major mining and manufacturing industries, and more specifically, primary metals, food products, petroleum products, chemicals, transportation equipment, fabricated metal products, machinery and bituminous coal (Gaughan, 2015). The first wave was characterized by horizontal mergers and industry consolidation, resulting in monopolies (Yaghoubi, 2016). The wave ended in 1904 with the implementation of anti-trust laws prohibiting monopolistic mergers (Yaghoubi, 2016).

- 1916-1929: The U.S. economy continued to grow, primarily as a result of the post-war economic boom, which provided the securities markets with significant investment capital (Gaughan, 2015). This led to the second wave, which was characterized by vertical mergers and oligopolies (Gaughan, 2015). The latter ended with the beginning of the great recession of 1929 (Gaughan, 2015).

- 1965-1969: The third wave was characterized by a booming economy, stricter anti-trust regulations in the United States, and conglomerate mergers (Yaghoubi, 2016). During this wave, many acquisitions were undertaken for the purpose of diversification, thereby reducing revenue volatility and risk. In addition, conglomerate mergers and acquisitions created an internal capital market that compensated for the imperfections of the external

capital markets (Yaghoubi, 2016). The wave ended at the end of the 60s when the oil crisis plunged the global economy into recession (Gaughan, 2015).

- 1981-1989: The fourth wave was triggered by new methods of financing (i.e., based on bank debt and junk bonds), changes in anti-trust laws, and innovations in electronics (Yaghoubi, 2016). This wave was characterized by highly leveraged hostile takeovers, which were considered highly profitable speculative operations (Gaughan, 2015). Another peculiarity of this wave was the massive size of the deals. Finally, the economic recession of 1990 and the collapse of the junk bond market led to the unravelling of highly leveraged deals and ended the fourth wave.

- 1993-2000: Consolidation and deregulation of the banking sector, in addition to dramatic changes in telecommunications and internet-related businesses, contributed to the fifth wave (Gaughan, 2015). Nevertheless, executives wanted to avoid the mistakes they made in the fourth wave (i.e., highly leveraged deals and short-term financial plays) and instead focused on strategic transactions (Gaughan, 2015). This wave was thus characterized by fewer hostile takeovers and more strategic mergers financed by equity. The fifth wave ended when the economy entered an 8-months recession in 2001 (Gaughan, 2015).

- 2003-2007: The availability of abundant liquidity led to the sixth wave (Gaughan, 2015). The low interest rate environment, in response to the 2001 economic shock, facilitated leveraged acquisitions by private equity firms (Gaughan, 2015). In addition, with the economy and the market booming, equity financing was easily available (Gaughan, 2015). During this period, private equity firms thrived and caused an appetite for mergers and acquisitions (Gaughan, 2015). Finally, the sixth wave ended in 2007 with the subprime crisis (Gaughan, 2015).

2.3 Nowadays

2.3.1 Global market

The purpose of this section is to provide an overview of the size of the global M&A market. To this end, numerous charts illustrating global and regional M&A activity are presented. Figure 1 shows the number and value of M&A transactions over the last two decades. In addition, Figures 2 and 3 compare global M&A activity to global GDP and global market capitalization so that the reader can better visualize the size of the M&A market. The Figures used to construct the charts can be found in the Appendices 1,2, and 3.

As we can see in Figure 1, at the end of the fifth wave around 2000, there is a peak in the value and number of M&A deals. In 1999, 18,022 M&A transactions take place, with a total volume of US$ 3,364 billion. This corresponds to 10.33% of world GDP and 10.04% of world market capitalization. Then, the dot-com bubble bursts, and M&A activity collapses. In 2002, the global volume of mergers and acquisitions is US$ 1,083 billion with 17,096 deals, which is equivalent to 3.12% of global GDP and 4.76% of global market capitalization.

In 2003, the sixth wave begins, and M&A activity rebounds. It peaks in 2007 with 28,835 deals for a total volume of US$ 4,169 billion. This represents 7.18% of global GDP and 6.98% of global market capitalization. Mergers and acquisitions being cyclical in nature, their activity plunges again to reach a trough in 2009, with 18,301 deals for a total value of US$ 1,483 billion. This represents 2.45% of the global GDP and 3.26% of global market capitalization.

Between 2010 and 2013, M&A activity is relatively low and stable. Approximately 20,000 deals are carried out each year, with a yearly value of just over US$ 2,100 billion.

In 2014, M&A activity skyrockets due to the low interest rate environment, rising stock prices, availability of cheap debt, and record levels of cash reserves (Hitchcock et al., 2018). In 2015, M&A activity reaches a peak with 28,634 transactions for a total value of US$ 4,932 billion, representing 6.56% of global GDP and 7.67% of global market capitalization.

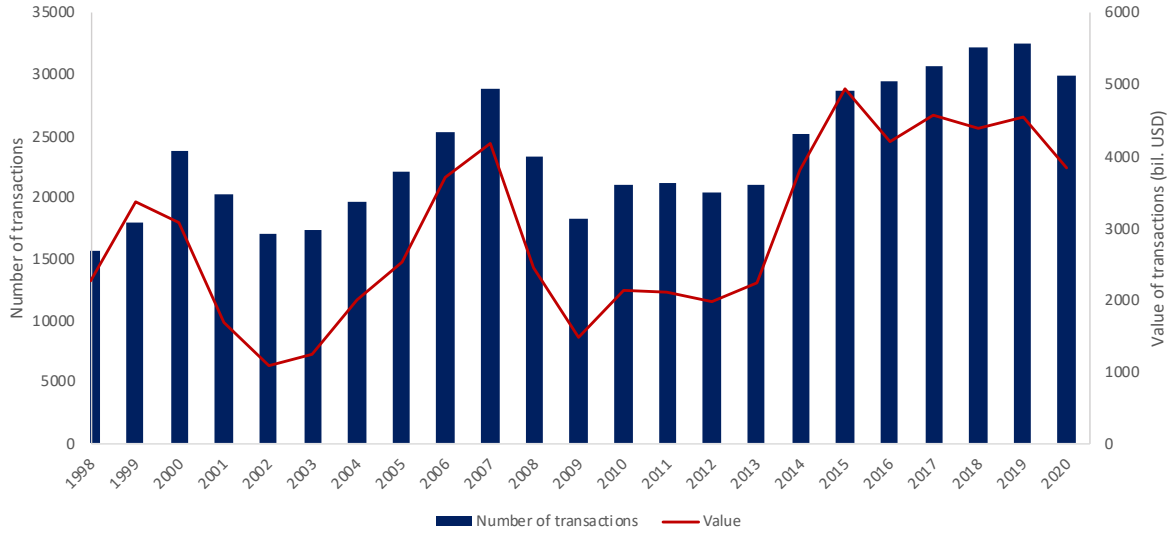
In the last few years, M&A activity has been rather stable, both in value and number of deals, although a little below the 2015 level. According to the Boston Consulting Group's report

"*The 2020 M&A report"*, four long-term trends are impacting the M&A market (Kengelbach et al., 2020). First, the low interest rate environment, which facilitates access to borrowing. Second, disruptive technologies such as digitalization, big data, artificial intelligence, automation, and advanced analytics. Third, industry consolidation and convergence. Finally, deglobalization due in part to political uncertainties and covid-19. Other trends such as sustainability, aging population, and urbanization are also impacting the M&A market (Kengelbach et al., 2020).

Finally, in 2020, M&A activity starts slowly and then plummets as COVID-19 starts to impact global supply chains and that investors start realizing the magnitude of the pandemic (Kengelback et al., 2020). As of mid-September, only 15 megadeals occurred compared to 27 for the same period in 2019 (Kengelback et al., 2020). In total, 2020 recorded 29,917 transactions worth US$ 3,846 billion, or 3.73% of global market capitalization. This is a decrease of 15.4% in value and 8.1% in the number of transactions compared to the previous year.

Figure 1

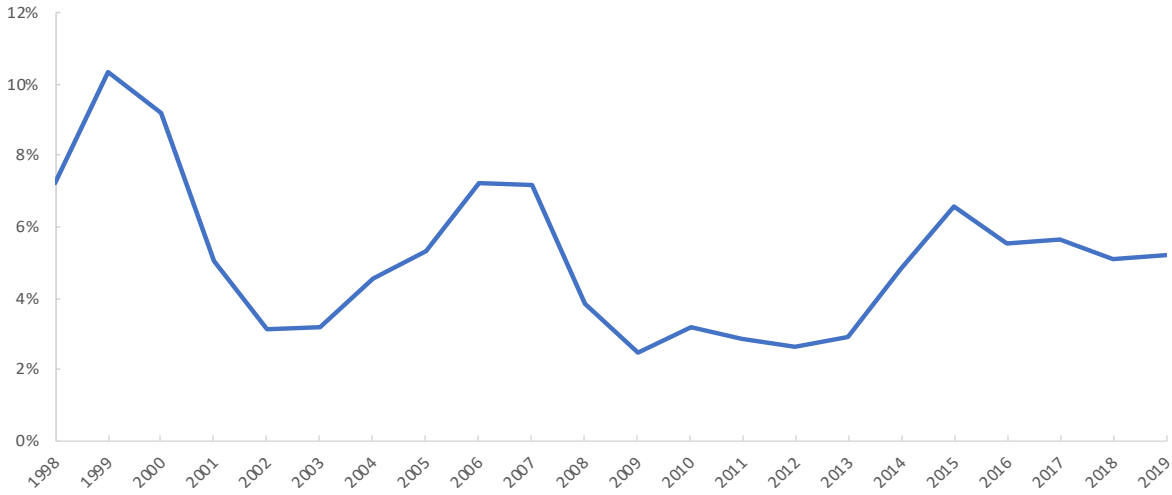
Number & Value of M&A Worldwide



Source: Bloomberg

Figure 2

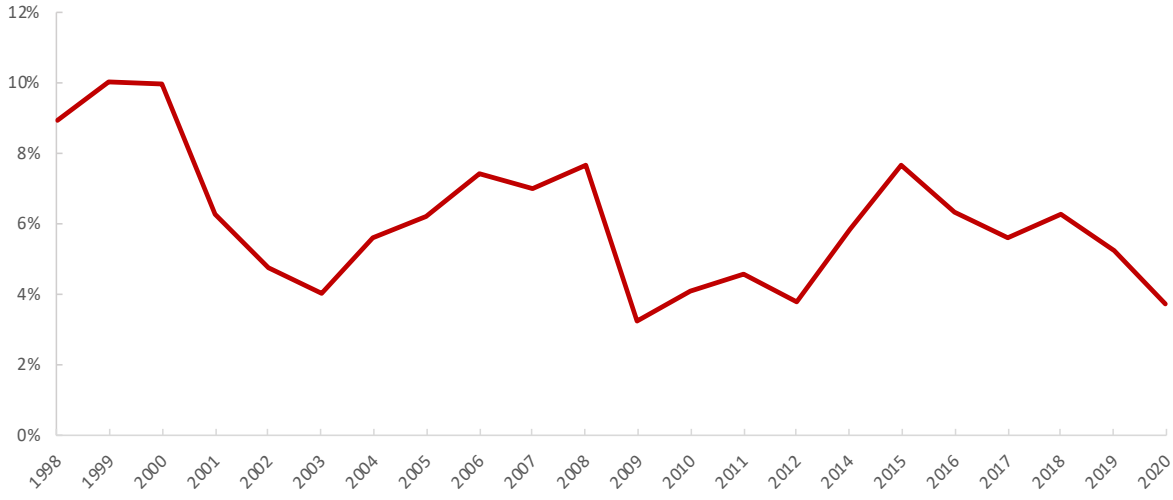
Ratio of global M&A activity to global GDP (in current $)



Source: World Bank, Bloomberg

Figure 3

Ratio of global M&A activity to world market capitalization



Source: World Bank, Bloomberg

2.3.2 Regional markets (North America, Western Europe, Asia-Pacific)

This section aims to provide an overview of the different regional markets and their relative size compared to the global M&A market. Figures 4 and 5 show the weight of the North American, Western European, and Asia-Pacific markets, respectively, in the value and number of deals in the global M&A market. Readers can refer to Appendices 4, 5 and 6 for more details on the value and number of deals by region per year[3].

The North American M&A market is the largest in terms of value and number of transactions. Its weight in the global market was moderately stable over the past 22 years. Indeed, it experienced an annual growth rate of -1.19% and 0.31% of its weight in value and in the number of transactions, respectively, in the global market. In 2020, the North American market represented 49.48% (US$ 1,903 billion) of the global M&A value and 42.84% (12,815) of the total number of transactions.

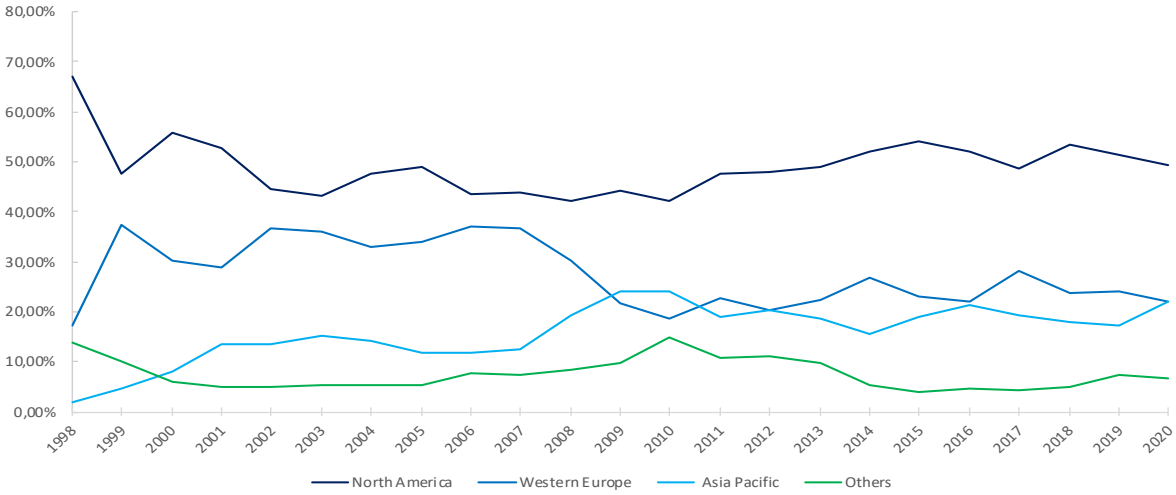
The Western European market is the second largest in terms of deal value and the third largest in terms of the number of transactions after North America and Asia-Pacific. Overall, from 1998 to 2020, the Western European market grew at an annual growth rate of 1.33% and 3.79% in relative value and number of deals compared to the global market, respectively. In 2020, the Western European market represented 22.13% (US$ 851 billion) of the global market value and 21.95% (6,567) of the total number of deals.

The Asia-Pacific M&A market experienced strong growth both in value and number of transactions over the last 22 years. It is now the second and third largest M&A market in terms of transactions and value, respectively. Between 1998 and 2020, Asia-Pacific weight in the global market experienced an annual growth rate of 47,98% in value and an annual growth rate of 32,56% in the number of transactions. However, these numbers are inflated due to the very small number of transactions in 1998, which makes these rates much higher than if one were to take the 2000-2020 period, for example. In 2020, the Asia-Pacific M&A market represented 21.87% (US$ 841 billion) and 28.01% (8,379) of the global M&A value and the total number of deals, respectively.

[3] All of the following calculations are my own and are based on the data in Appendices 1,4,5 and 6.

Figure 4

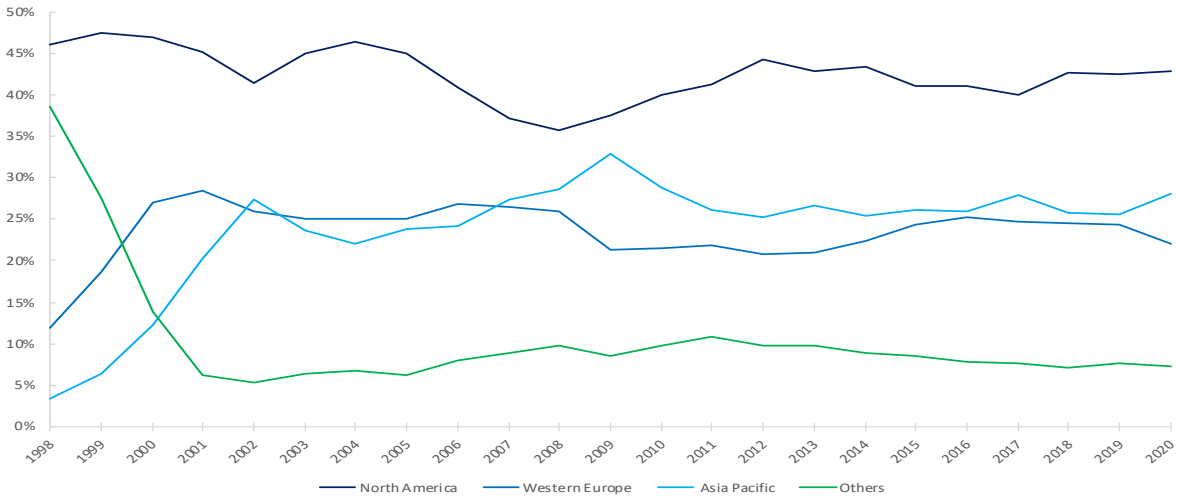
Geographical breakdown of M&A activity (in value)



Source: Bloomberg

Figure 5

Geographical breakdown of M&A activity (in number of transactions)



Source: Bloomberg

3 The renewable energy sector

Before we discuss the existing regulations in the renewable energy sector, we define what renewable energy is and how it is different from non-renewable energy.

Henrik Lund, in his book "Renewable Energy Systems: A Smart Energy Systems Approach to the Choice and Modeling of 100% Renewable Solutions", defines renewable energy as "energy that is produced by natural resources – such as sunlight, wind, rain, waves, tides, and geothermal heat – that are naturally replenished within a time span of a few years" (Lund, 2014, p. 8).

National Geographic defines non-renewable energy as "energy resources that are exhaustible relative to the human life span, such as gas, coal, or petroleum" (National Geographic, 2019).

3.2 European regulation

The energy sector in Europe currently accounts for more than 75% of its greenhouse gas emissions (European Commission, 2021). This sector is, therefore, a key element in the fight against global warming and in making Europe climate-neutral by 2050, which is the ambition of the EU. Therefore, this sector is subject to more and more regulatory changes. In this section, we explain the two major regulations put in place by the EU with regards to the renewable energy sector.

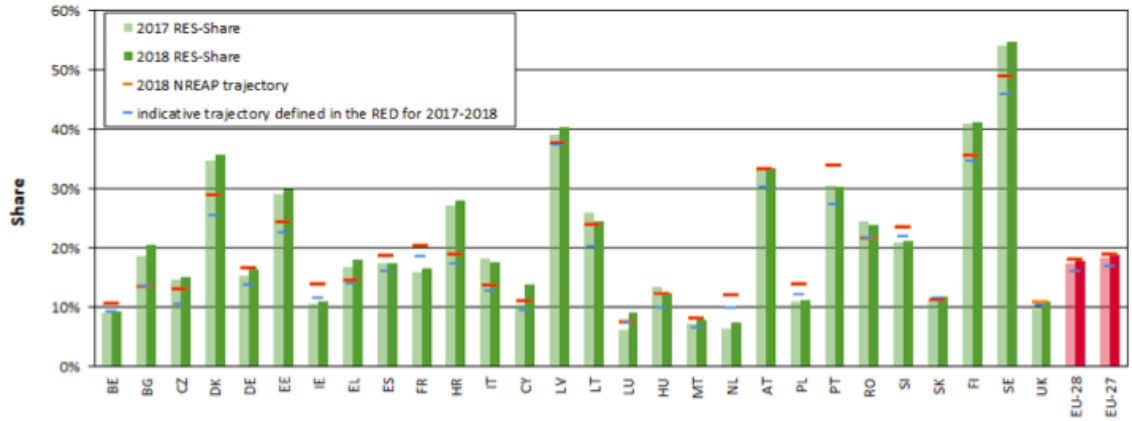
In January 2007, the European Commission presents the "Road Map for Renewable Energy in Europe". This road map promotes the increased use of renewable energy sources in Europe and suggests that there should be an overall legally target of 20% renewable energy in the EU's final energy consumption by 2020 (Ciucci, 2020). In addition, they call for biofuels to account for at least 10% of transport fuels by 2020 (Ciucci, 2020). In March 2007, the European Council approves these targets.

In April 2009, based on the European Commission's proposal, the European Parliament adopts the *Renewable Energy Directive (2009/28/EC)* (RED I), which promotes the production of renewable energy in the EU. Its objective is that at least 20% of Europe's energy needs and

at least 10% of the fuels used in transport come from renewable energy sources by 2020 (Renewable Energy Directive (2009/28/EC)). To achieve these figures, the UE sets binding targets for each country. Each country must implement a set of measures at the national level, called the National Renewable Energy Action Plan (NREAP), in order to meet these targets. Each country's action plan had to be communicated to the European Commission by June 30, 2010. Figure 6 shows the progress made by each country, and by Europe as a whole, in meeting these targets.

Figure 6

Renewable Energy Shares (RES) in gross final energy consumption in EU and its member states



Source: Renewable Energy Progress Report from the European Commission

In November 2016, the Commission publishes the "clean energy for all Europeans". In it, it sets a binding target of 27% of renewable energy source in the EU's final energy consumption (Ciucci, 2020).

In order to comply with the EU's COP 21 commitments on climate change and to meet its target of reducing its greenhouse gas emissions by 40% from 1990 levels by 2030, the *Renewable Energy Directive* is revised. A new version, the *Renewable Energy Directive (2018/2001/EU)* (RED II), comes into force in December 2018. The latter sets new targets: 32% of Europe's energy needs must come from renewable energy sources by 2030, with the possibility of increasing this number in 2023, and 14% of the fuels used in transport must come

from renewable sources by 2030 (Renewable Energy Directive (2018/2001/EU)). Each country was required to submit their National Energy and Climate Plans (NECPs) to the European Commission by the end of 2019. By June 2021, member states must transpose RED II into their legislation. On July 1, 2021, RED II enters into force.

3.3 U.S. regulation

Elliott (2013), a law professor at Yale Law School, emphasizes the difference between a plan and a policy in the context of the renewable energy sector. The United States has plans; for example, the Department of Energy (DEO) and the president must create a "national energy policy plan" every two years. However, when it comes to renewable energy policy in the United States, Elliott (2013) summarizes the situation as follow:

> For 35 years, the semi-annual national energy plans have been ignored. They are written, announced, and go directly into the dustbin of history. Unlike the Renewable Energy Directive in Europe, which creates binding obligations on the Member states, our national energy policy plan is merely a semiannual essay by the energy experts in the federal government that few read and no one follows. (Elliott, 2013, p. 2)

The remainder of this section explains key events that have impacted the U.S. renewable energy regulatory framework in the second half of the last decade.

In 2015, the United States joins the Paris Agreement at the COP21. However, in June 2017, Donald Trump announces his intention to withdraw from the Paris agreement. Nevertheless, the exit mechanism of this agreement prevents the United States from withdrawal before November 4, 2020, the day after the U.S. elections.

In October 2017, Donald Trump abolishes the Clean Power Plan, which was an Obama administration policy established in 2015. The latter required the energy sector to reduce its carbon emissions by 32% by 2030. This repeal aimed to fight a "war on coal" (Gibbens, 2019).

In June 2019, the Environmental Protection Agency (EPA) releases the final version of the Affordable Clean Energy act, intended to replace Obama's Clean Power Plan. The latter gives decision-making power to the states since it only gives them guidelines on how to limit carbon dioxide emissions, not legally binding targets. Fossil fuel-producing states are, therefore, likely to soften regulations (Nunez, 2017).

Part 2. Research Hypotheses and variables

1. Research Hypotheses

The objective of this paper is to determine whether the neoclassical theory can explain the increase of M&A activity in the renewable energy sector in Western Europe. Precisely, we assess the impact of the regulatory shock RED II on the number of transactions. In addition, we evaluate whether this regulatory shock required high capital liquidity to become a wave, as suggested by Harford (2005). Second, we study the impact of RED II in the United States, which has not experienced such a significant regulatory shock in this sector at the same time, to assess the credibility of our results in Western Europe. To this end, we formulate two hypotheses that will be tested empirically in the last part of this paper.

1.1 Hypothesis 1

Harford follows a neoclassical approach to explaining the clustering of M&A activity over time. He argues that merger and acquisition waves are the consequences of industry shocks, which can be economical, regulatory, or technological (Haford, 2005). These shocks lead firms in this industry to engage in large-scale reallocations of their assets. However, he adds that these shocks alone are not enough to create waves of mergers and acquisitions. Indeed, he argues that there must be sufficient capital liquidity, hence, low transaction costs, for these shocks to become waves.

Conversely, the behavioral explanation of merger waves states that clustering of M&A activity can be explained by high stock market valuations, as overvalued bidders use their shares to buy tangible assets from undervalued targets (Shleifer and Vishny, 2003). A well-known proxy for assessing market valuation is the price-to-book ratio[4] (Harford, 2005).

One sector that has experienced several shocks in recent years is the renewable energy industry. Specifically, multiple regulatory shocks have impacted the environment of the renewable energy sector in Europe in the last two decades. The objective of these regulations

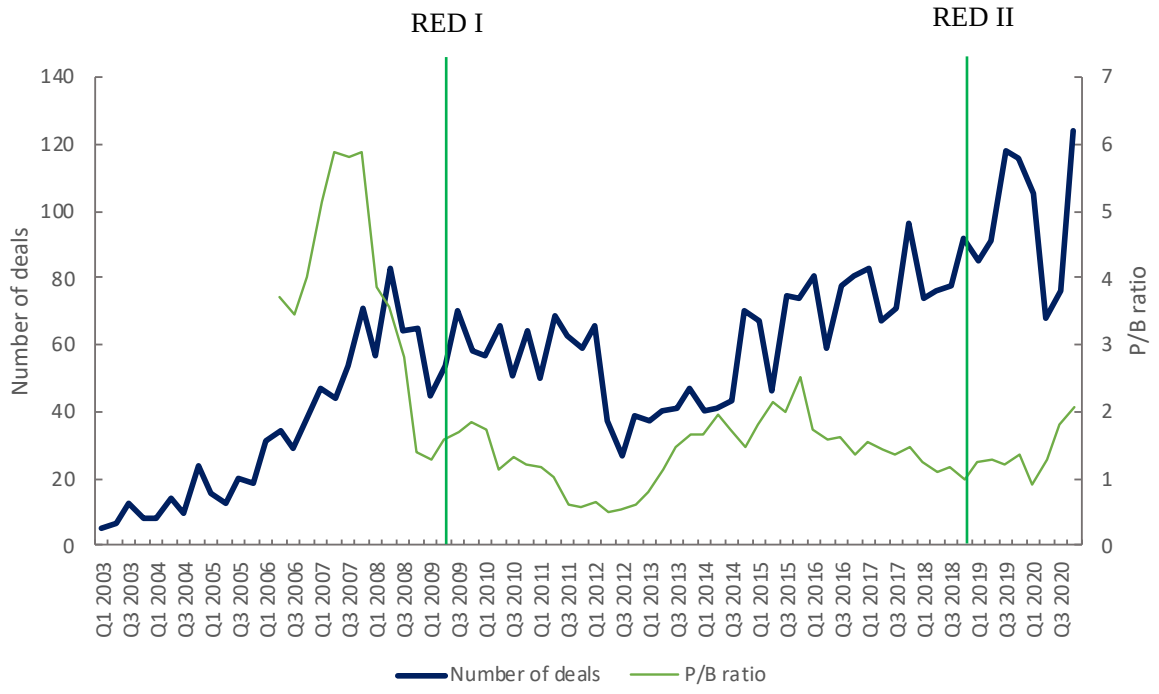
[4] The price-to-book ratio corresponds to the firm's market capitalization divided by its book value (Berk J. & DeMarzo P. (2020). Corporate Finance, Global Edition (5th Ed.). Pearson.)

is to contribute to the energy transition (i.e., switching from fossil energy to renewable energy) to fight global warming ultimately. Two major regulations are the *Renewable Energy Directive (2009/28/EC)* (RED I) and the *Renewable Energy Directive (2018/2001/EU)* (RED II), which is a recast of the first one. These directives encourage the production of renewable energy in the EU. Specifically, they set legally binding targets for the percentage of Europe's energy needs and the percentage of transport fuels that must come from renewable energy sources.

Therefore, I plotted the number of M&A deals in the Western European renewable energy sector in Figure 7, taking into account the behavioral and neoclassical frameworks. Indeed, the P/B ratio serves as a proxy for market valuation, while RED I and RED II correspond to the regulatory shocks. However, as we can see in Figure 7, it is worth taking a step back regarding the quality of the P/B ratio. Indeed, the P/B ratio on Bloomberg was given for the three sub-sectors of the renewable energy industry (i.e., biofuels, solar, wind), but not for the renewable energy sector as a whole. Since I did not find the different weights of these sub-sectors, I calculated the P/B ratio of the renewable energy industry by taking the average of these sub-sectors. Moreover, this ratio is for the renewable energy sector worldwide and not for Europe only, which was not available.

Figure 7

Comparison of M&A activity in the renewable energy sector to its price-to-book ratio (Western Europe)

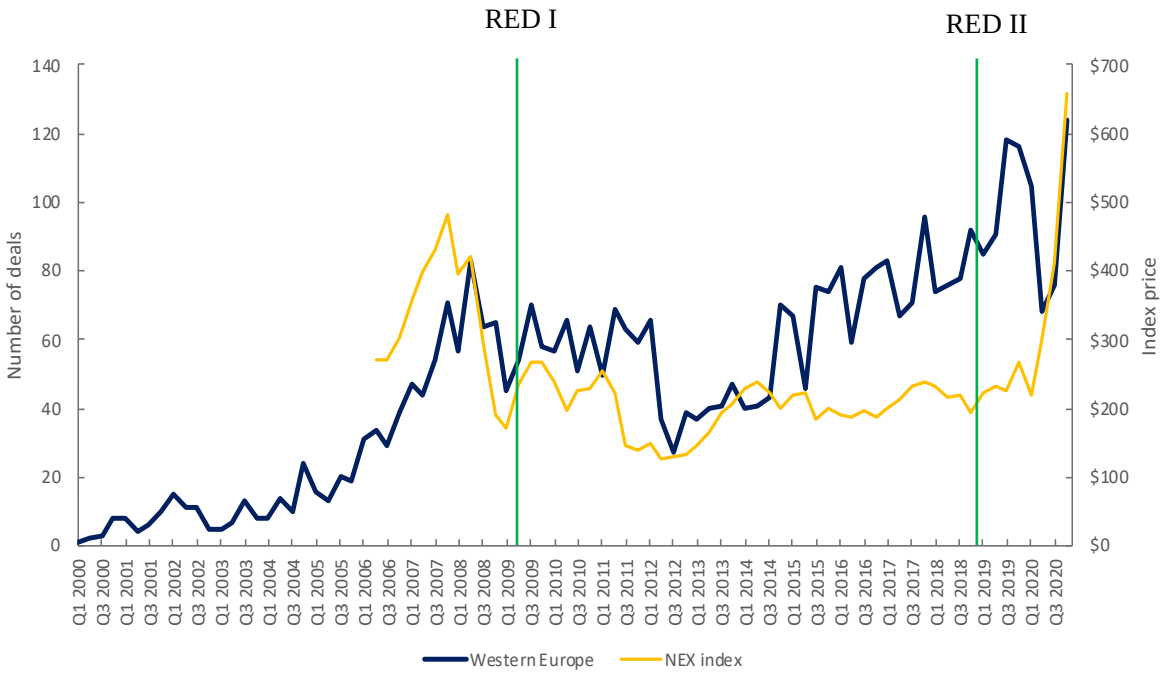


Source: Bloomberg

Because the reliability of the price-to-book ratio can be questioned, and because it does not seem to move in the same way as the number of transactions, I also compared the number of M&A deals to the Wilderhill New Energy Global Innovation Index (NEX) in Figure 8 to account for market valuation. This index is composed of "companies worldwide whose innovative technologies focus on clean energy renewables, decarbonization, and efficiency" (Wilderhill New Energy Global Innovation Index website). As of the first quarter of 2021, the index consisted of 102 companies, 38% from Western Europe and 29% from the United States. Table 1 shows the index composition.

Figure 8

Comparison of M&A activity in the renewable energy sector to the NEX (Western Europe)



Source: Bloomberg

Table 1

Wilderhill New Energy Global Innovation Index Sector Weights

Sectors	Number of enterprises	Index sector weights – Q1 2021
Renewable - Solar	28	27%
Renewable - Wind	21	20%
Energy efficiency	16	16%
Energy storage	15	15%
Energy conversion	11	11%
Renewables – Biofuels & Biomass	6	6%
Renewable - Other	5	5%

Source: Wilderhill New Energy Global Innovation Index website

We notice in Figure 8 that, in general, the number of M&A transactions follows a similar trend to the NEX. Around COP 21 in 2015, we notice an increase in the number of deals for the following years, while the index price remains stable. In addition, around the implementation of RED II in 2018, there is an increase in the number of deals. However, the regulatory event coincides with the peak of the NEX index, and thus high stock market valuations, which we need to take into account in our analysis.

It would also have been interesting to analyze the impact of the press and the evolution of the opinion on the M&A market in the months leading up to the directives. Nevertheless, this is beyond the scope of this master thesis.

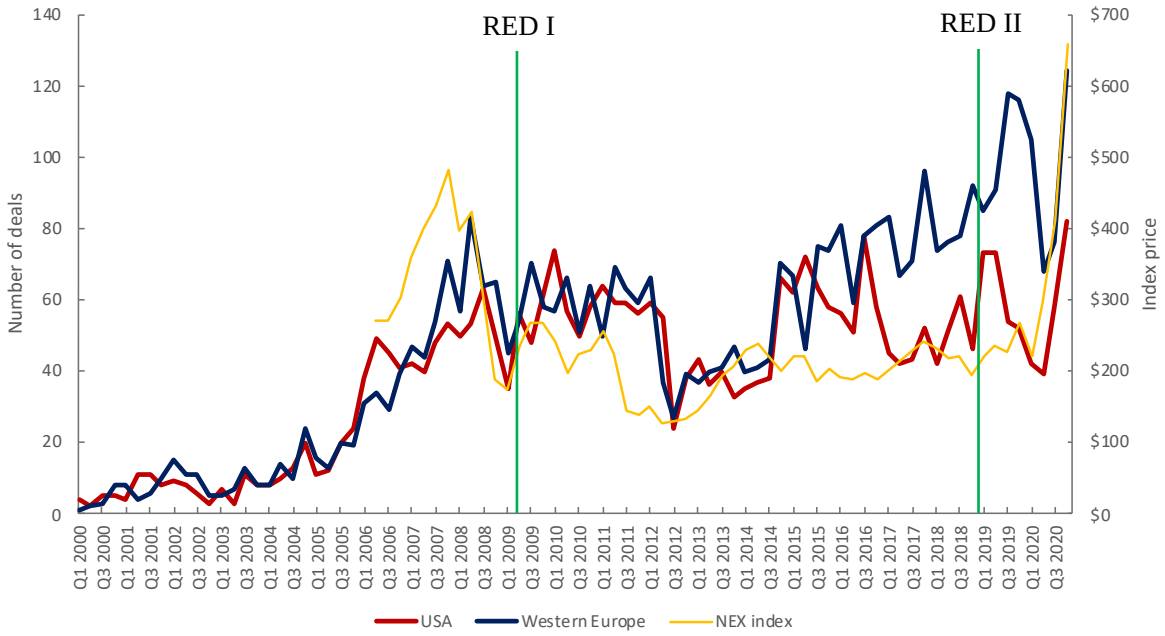
Finally, all of this leads us to study further the impact of these European policies in the renewable energy sector and assess whether they have led to an increase in the number of transactions, as predicted by the neoclassical approach. Due to the small number of deals in the renewable energy sector in the 2000s for which we had all the data we needed (i.e., 523), we chose not to investigate the latter but the second directive instead. Our first hypothesis is, therefore, the following:

$\mathbf{H_1}$: *The Renewable Energy Directive (2018/2001/EU) has increased the number of M&A deals in the renewable energy sector in Western Europe.*

1.2 Hypothesis 2

Figure 9

Comparison of M&A activity in Western Europe and the United States with the NEX



Source: Bloomberg

To get an idea of how the U.S. M&A market behaved during the same period, we plot the number of deals in the United States in Figure 9. We notice that during the period of Donald Trump's presidency, in which we witnessed a relaxation of renewable energy regulations in favor of an aggressive pro-fossil fuel policy, the number of transactions decreased. Conversely, the number of transactions increased during the same period in Western Europe. This reinforces our first hypothesis that the regulatory shock RED II played a role in the rise in the number of deals. Our second hypothesis is, therefore, the following:

H_2: The *U.S. renewable energy sector did not experience a surge of M&A deals as did Western Europe because it was not confronted with the regulatory shock RED II.*

2. Methodology

This section aims to describe the methodology we use to test our hypotheses. The latter follows Luo and Nazarov's (2019) study, which investigates whether the affordable care act can explain the wave of mergers and acquisitions in the U.S health insurance industry, and which is based on the work of Harford (2005). We use the same event-driven study to measure the impact of the *Renewable Energy Directive (2018/2001/EU)* on the number of transactions in Western Europe and the United States. To do so, we use the statistical software R.

2.1 Empirical Model

To test the impact of this policy on the number of M&A transactions, while controlling for the factors suggested by the behavioral and neoclassical frameworks, we use the following model for Western Europe and the United States:

$$Y_t = b_0 + b_1 RED2_{t-1} + X_{t-1} b + Z_{t-1} \gamma + \varepsilon_t$$

This empirical model is used by Luo and Nazarov (2019) to test whether the provisions of the affordable care act provisions are responsible for the M&A wave in the health insurance industry while controlling for behavioral and neoclassical factors. In their study, Luo and Nzarov (2019) use two models, one where Y_t is the number of months with an abnormal number of merger bids, and one where Y_t is the number of offers per year. They arrive at similar conclusions with their two models. Since we already have to perform the analysis on both Western Europe and the United States, and that the authors come to similar conclusions, we choose to test only one method. Thus, we consider Y_t to be the number of deals per year.

Based on their study, we take several variables that capture the potential determinants of merger waves. X_{t-1} represents the neoclassical determinants of merger waves, while Z_{t-1} represents the behavioral ones. The coefficient b_1, which is a proxy for post-November 2018 observations, is our parameter of interest as it identifies the potential impact of RED II on the number of M&A transactions.

We expect RED II to have a positive impact on Y_t for Western Europe, while it is expected to be about 0 for the United States, as it was not subject to this regulatory shock. Nevertheless, even if the directive did not directly impact the United States, it could still have an impact there, smaller than in Europe, due to globalization. Indeed, although they are two different parts of the world, there are not isolated from each other.

2.1.1 Explanatory variables supported by the neoclassical theory

As seen by Harford (2005), the neoclassical theory explains the occurrence of merger waves by economic or regulatory shocks, as well as by market liquidity. We can measure these economic shocks with several variables discussed previously in the literature in order to isolate the impact of the regulatory shock. These are cash flow margin (cash flow scaled by sales), ROA (net income scaled by total assets), asset turnover (sales divided by total assets), capital expenditure (scaled by total assets), employee growth rate, and finally, sales growth rate.

To avoid multicollinearity caused by the simultaneous inclusion of these variables in the regression, Luo and Nazarov (2005) use the principal components method to create a single variable capturing the characteristics of these variables. However, as we show in the empirical analysis, such an operation was not necessary in our case. Instead, we included all the variables in our regression.

Furthermore, the capital liquidity component of the neoclassical theory suggests that shocks are less likely to trigger M&A waves when market liquidity is low (Harford, 2005). Harford (2005) and Luo and Nazarov (2019) consider a year to be highly liquid if its price-to-book ratio is above its time-series median and the C&I rate spread is below its time-series median simultaneously. In our case, we use the EU short-term interest rate[5] as an inverse measure of market liquidity in Western Europe. A year of high liquidity is a year for which the short-term interest rate is below its time-series median. For the United States, we use the Bloomberg FDFD index, which corresponds to the federal funds rate[6], in order to be coherent

[5] Definition of the short-term interest rate: "Short-term interest rates are the rates at which short-term borrowings are effected between financial institutions or the rate at which short-term government paper is issued or traded in the market" (OCDE).
[6] Definition of the federal funds rate: "The federal funds rate is the interest rate at which depositary institutions trade federal funds (balances held at Federal Reserve Banks) with each other overnight" (Federal Reserve Economic Data)

with the rate we chose for Western Europe. We decide not to consider the P/B ratio in determining liquidity as we do not know its relevance to our datasets. Indeed, as explained above, I took the average of the three sub-sectors to compute the P/B ratio. Furthermore, the latter concerns the whole world, not just Western Europe or the United States. Therefore, due to its lack of reliability, we do not consider it to determine capital liquidity.

2.1.2 Explanatory variables supported by the behavioral theory

According to the behavioral approach, firms engage in M&A to use their overvalued stock to acquire assets of undervalued firms (Shleifer and Vishny, 2003). As Luo and Nazarov (2019), we use the market-to-book ratio as a proxy for market valuation. In addition, we use the 30-days-volatility[7] and the monthly returns of the NEX for a four-year period before RED II. We choose to consider data four years prior to RED II rather than three as in Luo and Nazarov's (2019) study. This is because the categorical variable accounting for the market liquidity takes on the value "low liquidity" for the U.S. dataset in the three years prior to RED II, which prevents the multiple linear regression from accounting for both market liquidity and the NEX during this period.

3. Data

All the M&A data presented in this paper come from the UCL[8] Bloomberg terminal. Other databases more specialized in M&A might have been more suitable for this work, but unfortunately, I did not have access to them.

To retrieve the deals in the renewable energy sector, I used the Bloomberg M&A classification, which is detailed in Table 2. Expressly, I set the bidder's industry to renewable energy. In addition, I defined the location of the acquirer as Western-Europe for our first dataset and the United States for the second.

[7] The 30-day volatility measure from Bloomberg is defined as follow "The 30-day price volatility is equal to the annualized standard deviation of the relative change in closing prices over the last 30 trading days, expressed as a percentage"
[8] Université catholique de Louvain

Table 2

Bloomberg M&A industry classification

Industry	Sub-industry	Sub-industry
Level 1	**Level 2**	**Level 3**
Raw materials		
Communications		
Cyclical goods		
Non-cyclical goods		
Diversified		
Finance		
Industrial		
Technology		
Utilities		
Energy	Oil & gas	
	Pipelines	
	Renewable energy	**Biofuels**
		Solar
		Wind
	Oil and gas services	
	Coal	

I retrieved the deals with these parameters from 2010 to 2019, resulting in 951 deals for Western Europe and 686 deals for the United States. Because the independent variables in our regression model at year t-1 predict the number of M&A deals at year t, I could not include the 2020 deals as we did not know the total amount of deals in 2021 yet. Once I removed the observations for which I did not have data for all the variables, the datasets comprised 461 and 459 observations for Western Europe and the United States, respectively. Finally, after removing the outliers, the European and U.S. datasets included 406 and 422 data.

The neoclassical variables (i.e., cash flow margin, ROA, asset turnover, capital expenditure, employee growth, sales growth) were also taken from Bloomberg. Since the cash

flow margin was not available on its own, I divided each firm's operating cash flow by its sales. As for the data on employees and sales growth, it was not given as a percentage but as an integer. Finally, The European short-term interest rate comes from the OCDE database, while the federal funds rate comes from Bloomberg

For the behavioral variables, the P/B ratio and the NEX data (i.e., market valuation and standard deviation) also come from Bloomberg.

Part 3. Empirical analysis and results

1. Descriptive statistics

The first step in our empirical analysis is to become more familiar with our data through descriptive statistics. Descriptive statistics give you a better understanding of the characteristics of your data, which is essential for conducting your analysis and interpreting your results (Herbst et al., 2020). Specifically, it provides you with information such as the mean, median, and variance. We use the summary function of R to get an overview of our two datasets, more precisely, the mean, median, quartiles, and maximum and minimum values.

By looking at the summary of the variables of the European dataset, we can question some of our data. Indeed, the variables *Cash flow margin*, *Sales growth*, *ROA*, and *Employee growth* seem to take extreme values with respect to their quartile. For instance, *ROA* has a minimum value of -15, or -1500%, which is financially questionable. Therefore, we plot the different values that each of these variables can take. The plots are presented in Appendix 8.

We notice that these variables take on extreme values called outliers. Kwak and Kim (2017) define outliers as "extreme values that abnormally lie outside the overall pattern of a distribution of variables" (Kwak and Kim, 2017, p. 407). Outliers introduce bias into parameter estimates because they affect, among other things, mean values (Kwak and Kim, 2017). Therefore, it is essential to address them before proceeding further in our analysis.

One way to do this is to use the interquartile range, which is the difference between the 3rd and 1st quartile of each variable, thus including 50% of the values. A general rule of thumb is to exclude an observation if it is above the 3rd quartile plus 1.5 times the interquartile range or below the 1st quartile minus 1.5 times the interquartile range (Vinutha et al., 2018). However, because we have many extreme values, using 1.5 times the interquartile range removes 60, 52, 57, and 62 observations from the variables *Cash flow margin*, *Sales growth*, *ROA* and *Employee growth*, respectively. Since this represents more than 10% of our data, we use trial and error to find a more appropriate value than 1.5 by plotting the variables for different multiples of the interquartile range. Finally, we use seven times the interquartile range for the variable *Employee growth* and eight times for *ROA*, *Sales Growth* and *Cash flow margin.* It eliminates 12, 7, 10

and 19 observations, respectively. The plots of the variables without the outliers can be found in Appendix 9.

We take a similar approach for the U.S. dataset. We find extreme values for the variables *Cash flow margin*, *Sales growth*, *ROA*, *Employee growth* and *Asset turnover*, which are plotted in Appendix 10.

Using 1.5 times the interquartile range, we remove 41, 35, 83, 48, and 28 observations from the variables *Cash flow margin*, *Sales growth*, *ROA*, *Employee growth* and *Asset turnover*, respectively. Therefore, we also use trial and error to find a more appropriate value for the interquartile range multiple. We use five times the latter for *Asset turnover*, eight times for *Sales growth*, *Cash flow margin*, *Employee growth*, and 14 times for *ROA*. It leads to the removal of 5,4,4,8 and 14 observations for these variables, respectively. The plots can be found in Appendix 11.

2. Correlation

The next step consists of examining the relationships between the independent variables. Indeed, we do not want our variables to be too correlated as it would lead to multicollinearity. Firmly collinear variables are variables for which there exists a perfect or near-perfect linear relationship between them (Rahayu et al., 2017). The absence of multicollinearity is an assumption of multiple linear regression that we must respect (Van Bellegem, 2015). Indeed, the issue with multicollinearity is that the regression coefficient of some of our variables could become insignificant when regressed with other independent variables when they could be significant if regressed separately with the dependent variable (Rahayu et al., 2017). We consider independent variables to be highly collinear if their regression coefficient is greater than 80% (Gujarati, 2013; as cited in Rahayu et al., 2017).

We compute the correlation between our independent variables using Spearman correlation coefficient. The latter is a non-parametric statistical measure of the correlation of two variables, which does not require any assumptions about the distribution of our variables (Xiao et al., 2016). This correlation coefficient is known to have lower variability than Pearson's coefficient for non-normal distributed variables, which is our case (de Winter et al., 2016). Therefore, a strong correlation between two variables using Spearman correlation coefficient implies that the two variables have a monotonic but not necessarily linear relationship (Puth et al., 2015).

Figures 10 and 11 provide visual representations of the correlation between the variables in the Western European and U.S. datasets, respectively. Appendices 12 and 13 give the exact values. As we can see in Figure 10, our independent variables for Western Europe are almost uncorrelated. Indeed, the most correlated variables are *Short-term interest rate* and *NEX price variation* with a value of 75.3%. Our variables are even less correlated in the U.S. dataset. Indeed, the highest correlated variables are *Employee growth* and *Sales growth*, with a correlation coefficient equal 42.3%.

Figure 10

Correlation plot between the independent variables using Spearman coefficient (Western Europe)

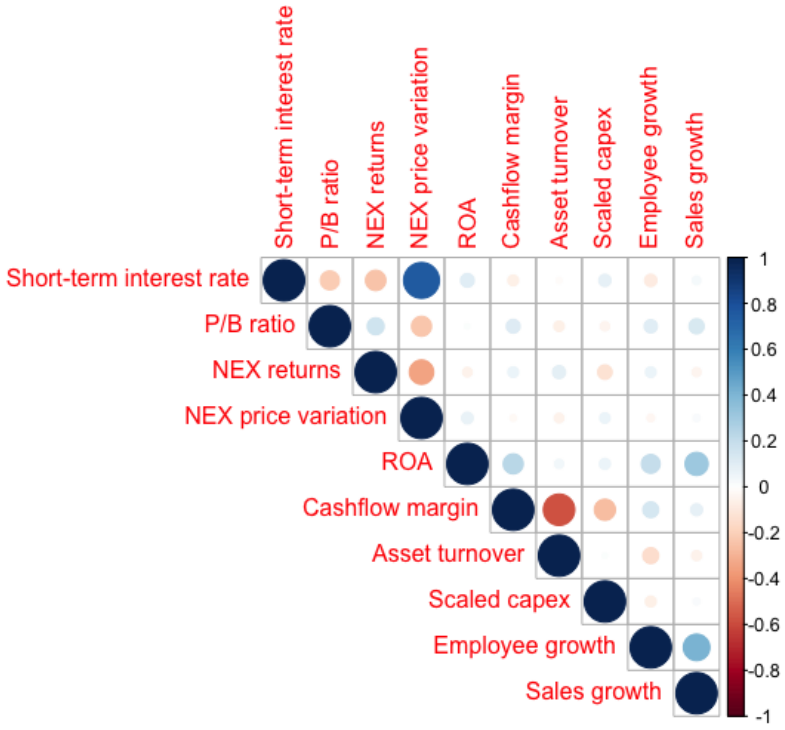
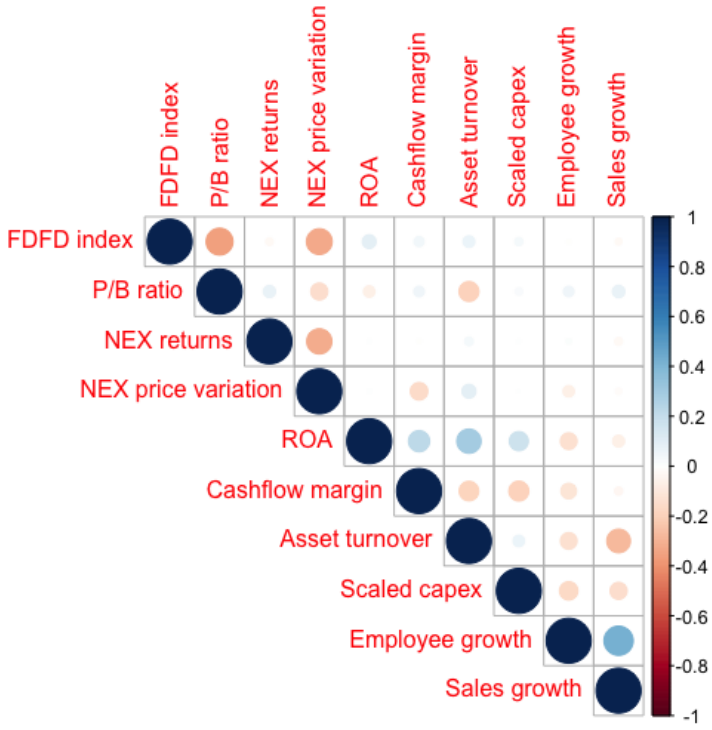


Figure 11

Correlation plot between the independent variables using Spearman coefficient (United States)



In their study, Luo and Nazarov (2019) use Principal Component Analysis (PCA) to handle multicollinearity. This method aims to reduce the dimensionality of the dataset while retaining as much variability as possible (Jollife and Cadima, 2016). PCA produces new variables that are linear functions of the original ones, consecutively maximizing variance, and uncorrelated with each other (Jollife and Cadima, 2016).

However, because our variables are not highly correlated, we will not use the first principal component in our regression model. Out of curiosity, we still perform PCA on both the European and U.S. datasets; the results can be found in Appendices 14 and 15. We notice that the first principal component captures only 28.85% of the variability of the neoclassical variables for the European dataset and only 25.36% for the U.S. dataset. Since the variables are not strongly correlated, the principal component analysis cannot capture much of the variability of these variables. Therefore, we include all of our neoclassical variables instead directly in the regression models in order not to lose too much information.

3. Regression

Now that we have cleaned our datasets and ensured no multicollinearity between our independent variables, we can run the linear regressions to address our two hypotheses. In total, we run four regressions for each dataset.

The first model is a simple linear regression that only includes the impact of RED II on the number of M&A transactions per year. The second model takes into account the neoclassical variables in addition to RED II. The third model includes the behavioral variables. Finally, the fourth model takes into account the variables included in both the neoclassical and behavioral frameworks, in addition to RED II. The results of these regressions are presented in Table 3 for Western Europe and in Table 4 for the United States.

Table 3

Regression models predicting the number of deals per year (Western Europe)

Variables	Model 1	Model 2	Model 3	Model 4
Regulatory Event (RED 2)	46.781***	21.635***	17.202***	9,290***
	(1.658)	(1.486)	(1.076)	(0.972)
Behavioral factors				
P/B ratio			-23..785***	-10.794***
			(2.273)	(1.003)
4-year NEX returns			-13.794	20.698***
			(9.378)	(6.041)
4-year NEX price variation			0.036	-0.007
			(0.092)	(0.057)
Neoclassical factors				
Short-term interest rate		-41.218***		-61.204***
		(1.578)		(4.371)
Tight capital		6.186***		16.938***
		(1.545)		(0.930)
ROA		-2.095		-1.572
		(16.332)		(6.316)
Cashflow margin		-3.512		-1.152
		(5.096)		(2.246
Asset turnover		0.158		-0.765
		(2.267)		(0.753)
Scaled capex		-25.102		1.449
		(24.330		(8.307)
Employee growth		0.048		-0.004
		(0.071)		(0.025)
Sales growth		-0.138**		-0.036*
		(0.043)		(0.014)
Intercept	101.152***	105.411***	160.840***	118.357***
	(1.658)	(1.902)	(3.462)	(2.989)
R-squared	**0.333**	**0.756**	**0.740**	**0.897**

Robust standard errors in parantheses; *** p<0.001, ** p<0.01, * p<0.05

As shown in Table 3, when considered alone, *RED 2* increases the number of M&A deals per year by 46.8 with a statistical significance level of 0.001. Once we add the variables suggested by the neoclassical and behavioral frameworks, this value drops to 9.3, with still a statistical significance at the 0.001 level.

Table 4

Regression models predicting the number of deals per year (United States)

Variables	Model 1	Model 2	Model 3	Model 4
Regulatory Event (RED 2)	-3.748***	7.007***	10.305***	1.052
	(0.085)	(0.713)	(0.889)	(0.931)
Behavioral factors				
P/B ratio			22.016***	15.734***
			(1.395)	(3.794)
4-year NEX returns			-15.945	2.216
			(13.732)	(4.597)
4-year NEX price variation			-0.172	-0.231***
			(0.140)	(0.048)
Neoclassical factors				
FDFD index		-1.030		9.160***
		(0.701)		(0.961)
Tight capital		-17.721***		-22.023***
		(1.522)		(1.822)
ROA		-4.171		0.129
		(6.374)		(2.456)
Cashflow margin		-0.874		0.581
		(2.160)		(0.554)
Asset turnover		-0.199		0.295
		(1.050)		(0.396)
Scaled capex		33.912*		12.833*
		(15.565)		(5.668)
Employee growth		0.032		0.012
		(0.022)		(0.021)
Sales growth		0.020		0.027**
		(0.022)		(0.010)
Intercept	68.139***	78.376***	28.389***	48.530***
	(0.797)	(1.507)	(2.181)	(7.773)
R-squared	**0.006**	**0.352**	**0.473**	**0.909**

Robust standard errors in parantheses; *** p<0.001, ** p<0.01, * p<0.05

Table 4 shows that, when considered alone, *RED 2* decreases the number of deals in the United States. However, given that the R-squared of the model is equal to 0.006, we can confidently say that the coefficients of this regression are not reliable. When controlling for the variables that account for both the neoclassical and behavioral theory, we find that RED II has no impact on the number of deals in the United States.

4. Cook's Distance

Cook's distance is a measure used to gauche the influence of each observation in regression models (Jayakumar et al., 2015). This method allows us to find which data are highly influential in our model and remove them from our dataset. The Cook's distance of the *ith* observation can be computed as follow (Jayakumar et al., 2015)

$$D_i = \frac{1}{(p+1)\widehat{\sigma_e^2}}\left(\hat{\beta} - \underset{(-i)}{\hat{\beta}}\right)^T X^T X\left(\hat{\beta} - \underset{(-i)}{\hat{\beta}}\right)$$

A rule of thumb is to exclude observations with a Cook's distance greater than 4/(n-p), where n is the number of observations and p is the number of predictors (Bollen et al., 1990; as cited in Jayakumar et al., 2015). We plot Cook's distance for each observation in our European and U.S datasets (see Appendices 16 and 17). The blue line represents the cut-off value above which we exclude observations. We remove 22 outliers for Western Europe and 19 for the United States.

Finally, we run the same regressions with the remaining 404 observations for Western Europe and 422 for the United States. The results of the regressions without outliers are presented in Table 5 and Table 6.

Table 5

Regression models predicting the number of deals per year without outliers (Western Europe)

Variables	Model 1	Model 2	Model 3	Model 4
Regulatory Event (RED 2)	47.330***	21.763***	17.016***	8.006***
	(1.669)	(1.647)	(1.112)	(1.041)
Behavioral factors				
P/B ratio			-23.674***	-10.535***
			(2.310)	(0.968)
4-year NEX returns			-8.654	20.512***
			(9.501)	(5.529)
4-year NEX price variation			0.089**	0.018
			(0.096)	(0.051)
Neoclassical factors				
Short-term interest rate		-40.825***		-63.982***
		(1.634)		(4.116)
Tight capital		6.263***		18.340***
		(1.683)		(0.932)
ROA		-10.455		-1.938
		(18.829)		(5.031)
Cashflow margin		-1.295		-1.322
		(5.482)		(1.756)
Asset turnover		0.707		-0.668
		(2.367)		(0.633)
Scaled capex		-32.174		-0.649
		(25.573)		(7.740)
Employee growth		0.034		-0.011
		(0.076)		(0.023)
Sales growth		-0.146**		-0.047**
		(0.047)		(0.016)
Intercept	100.591***	104.239***	159.869***	115.995***
	(1.669)	(1.981)	(3.543)	(2.722)
R-squared	**0.315**	**0.748**	**0.731**	**0.915**

Robust standard errors in parantheses; *** p<0.001, ** p<0.01, * p<0.05

As we can see in Table 5, the results are similar to those from Table 3 before removing the outliers. Indeed, RED II increases the number of M&A transactions in Western Europe per year by 8 instead of 9. Furthermore, the regulatory event is still statistically significant at the 0.001 level.

Table 6

Regression models predicting the number of deals per year without outliers (US)

Variables	Model 1	Model 2	Model 3	Model 4
Regulatory Event (RED 2)	-3.733***	7.160***	10.409***	2.440**
	(0.878)	(0.660)	(0.934)	(0.742)
Behavioral factors				
P/B ratio			23.399***	6.850***
			(1.599)	(1.509)
4-year NEX returns			-12.484	5.982*
			(14.644)	(2.941)
4-year NEX price variation			-0.209	-0.235
			(0.147)	(0.035)
Neoclassical factors				
FDFD index		-0.877		7.277***
		(0.700)		(0.536)
Tight capital		-17,888***		-26.666***
		(1.547)		(0.687)
ROA		-7.025		-0.406
		(7.105)		(2.084)
Cashflow margin		-0.977		0.372
		(2.231)		(0.470)
Asset turnover		-0.101		0.164
		(1.072)		(0.320)
Scaled capex		36.614*		11.186*
		(16.462)		(4.644)
Employee growth		0.031		-0.007
		(0.036)		(0.011)
Sales growth		0.020		0.022**
		(0.024)		(0.007)
Intercept	68.082***	78.458***	27.064***	67.237***
	(0.819)	(1.577)	(2.482)	(2.910)
R-squared	**0.006**	**0.354**	**0.460**	**0.947**

Robust standard errors in parantheses; *** p<0.001, ** p<0.01, * p<0.05

Conversely, the removal of the outliers has mildly changed the results of the regression for the United States. Indeed, the coefficient is now slightly positive and is statistically significant at the 0.01 level.

5. Multiple linear regression assumptions

In the previous section, we looked at the significance of the regression coefficients and the R-squared of the models. However, looking at these indicators alone is not sufficient to quantify the quality of our models. Indeed, multiple linear regression models are based on several assumptions which need to be satisfied for the model to be valid. We have already addressed multicollinearity, which is an assumption of multiple linear regression. In this section, we examine the remaining assumptions and assess their implications on the efficiency and reliability of our fourth model without outliers for the two datasets.

5.1 Linearity

The first assumption of linear regression is that there is a linear relationship between the independent and dependent variables.

In Appendix 18, we plot the residuals against the fitted values of the European model to get an idea of the linearity. We notice that the red line is not horizontal and at zero as it should be to satisfy the linearity assumption. To better understand the relationship between the dependent variable and the predictors, we plot the residuals of each independent variable alone, attempting to explain the dependent variable. On these graphs, available in Appendix 20, we notice that *Short-term interest rate*, *NEX returns*, and *NEX price variation*, which are significant in our model, have a more or less linear relationship with the number of deals. This is less the case for *P/B ratio*.

We follow a similar approach for the United States. As we can see in Appendix 19, the red line is more horizontal and closer to zero than for Western Europe, although the relationship is still not perfectly linear. The relationship between each independent variable and the dependent variable is shown in Appendix 21. We notice that among the statistically significant variables, *FDFD index*, *P/B ratio* and *Capital expenditure* have a more or less linear relationship with the number of deals.

Therefore, most of the statistically significant variables have a sort of linear relationship with the dependent variable, both for Western Europe and for the United States.

5.2 Normality of the residuals

An essential assumption of ordinary least square (OLS) estimators in linear regression is the normal distribution of the residuals (Van Bellegem, 2015). To get an idea of the normality of the residuals of our models, we build two Q-Q (Quantile-Quantile) plots. These plots, which can be found in Appendices 22 and 23, compare the distribution of the models' residuals to the residuals of a normal distribution. If the assumption of normality of the residuals is satisfied, most of the points should be distributed on the diagonal line. At first glance, the residuals do not appear to be normally distributed.

To statistically test whether the residuals of our regression models are normally distributed, we use the Jarque-Bera test, which is based on kurtosis and skewness. The null hypothesis is that the data follow a normal distribution. Using the Jarque-Bera test, we obtain a p-value of 1.515e-06 for our two datasets, which implies that our residuals are not normally distributed.

Nevertheless, even if the residuals are not normally distributed, the estimators produced by OLS are still consistent and unbiased (Van Bellegem, 2015). What changes is the estimators' variance, which makes the interval confidences and significance tests no longer reliable (Van Bellegem, 2015). The following section explains how to compensate for this lack of reliability.

5.3 Homogeneity of residuals variance

Linear regression relies on the assumption of homoscedasticity, which means that the conditional variance of the error term remains constant (Van Bellegem, 2015). If this assumption is violated, the ordinary least square estimators are still unbiased, but their variance changes, implying that confidence interval calculations are no longer reliable. Therefore, the t-tests used in the regressions do not provide us with values that are still relevant since they are based on an inconsistent covariance matrix estimator (Cribari-Neto and Maria da Gloria, 2014).

We can see in Appendix 24 that the residuals of the European model are not equally distributed along a horizontal line as they should when there is no heteroscedasticity. For the American model, Appendix 25 suggests that the variance of the error term is more constant than for Western Europe. We go further and assess the homoscedasticity assumption using the

Breush-Pagan test. Its null hypothesis indicates that the variance of the error terms is constant, while the alternative hypothesis suggests the presence of heteroscedasticity. The tests give us a p-value of 2.2e-16 for the regression on the European dataset and 1.902e-06 for the regression on the U.S. dataset. Therefore, we reject the null hypothesis and cannot prove that we face homoscedasticity.

To compensate for potential heteroscedasticity, we compute robust covariance matrix estimators, which are defined as

$$HC0 = (X'X)^{-1}X'diag[e_2^i]X(X'X)^{-1}$$

With $[e_2^i]$ a diagonal matrix comprising the squared OLS residuals on the main diagonal and zero elsewhere (Hayes and Cai, 2007). Next, we compute robust standard errors based on these covariance matrix estimators and assess whether the statistical significance of the predictors has changed. The multiple regression presented in Tables 3,4,5, and 6 already took into account the robust standard errors, which are displayed between brackets below each regression coefficient.

6. Results

Now that we have removed the outliers and accounted for the multiple linear regression assumptions, we can discuss the final results of our regressions for Western Europe and the United States, which are presented in Tables 5 and 6, respectively.

For Western Europe, when we do not control for the variables included in the neoclassical and behavioral frameworks, the *Renewable Energy Directive (2018/2001/EU)* increases the number of deals per year by 47.3, with a p-value smaller than 0.001. Once we add the variables from both frameworks, this number drops to 8, with a p-value that is still smaller than 0.001. In addition, the R-squared of the regression model is equal to 0.915, which gives credibility to our results. The R-squared value indicates the extent to which the regression model explains the variability in the data; the higher the R-squared, the more the model explains the variability of the data (Van Bellegem, 2015). Overall, the regression results confirm our

first hypothesis that RED II has had a positive impact on the number of M&A deals in the renewable energy sector in Western Europe.

For the United States, if we only consider the impact of the *Renewable Energy Directive (2018/2001/EU)* on the number of deals per year, it decreases it by 3.7. Although the indicator has a p-value smaller than 0.001, the R-squared of the model is equal to 0.006, which makes these results not reliable. Once we add the neoclassical and behavioral variables, this number increases to 2.4 with a p-value smaller than 0.01 and an R-squared value of 0.947. We can conclude that RED II has had a limited impact on the number of M&A transactions in the United States, confirming our second hypothesis.

Concerning capital market liquidity, for which Harford (2005) argues that industry shocks require high capital liquidity to trigger M&A waves, we arrive at contradictory results. For the United States, the variable *tight capital* decreases the number of M&A deals, as expected, according to Harford (2005). Indeed, the coefficient is equal to -26.6 and is statistically significant at the 0.001 level. Conversely, the same variable increases the number of deals in Western Europe. Indeed, the coefficient is equal to 18.3 and is also statistically significant at the 0.001 level. Therefore, this study does not allow us to confirm Harford's (2005) hypothesis regarding capital market liquidity.

Finally, we notice unexpected differences in the sign of the P/B ratio between the United States and Western Europe. Indeed, the variable *P/B ratio* is strongly negative for Western Europe while it is positive for the United States. According to the behavioral theory, high market valuations lead to the clustering of M&A activity, making the sign of *P/B ratio* unexpected for Western Europe.

Conclusion and perspectives

It is well known in the literature that mergers and acquisitions tend to occur in waves (Harford, 2005). However, there is no consensus on what triggers these waves (Harford, 2005). The competing explanations can be classified into two groups: neoclassical and behavioral (Harford, 2005). On the one hand, the neoclassical theory argues that economic, technological, and regulatory shocks in an industry lead firms to engage in large-scale reallocations of their assets (Mitchell and Mulherin, 1996). Harford (2005) adds that these shocks alone are not enough to trigger M&A waves but that they also require sufficient capital liquidity. On the other hand, behavioral theory argues that the clustering of M&A activity over time is driven by high stock market valuations. The latter claims that managers would take advantage of their overvalued shares to acquire assets from undervalued targets (Shleifer and Vishny, 2003).

Since the number of M&A deals in the Western European renewable energy sector increases shortly after the implementation of the *Renewable Energy Directive (2018/2001/EU)* (RED II), our first hypothesis argues that the directive is responsible for this increase of M&A activity, based on the neoclassical theory. Conversely, during the same period, we notice a decrease in M&A deals in the United States, which follows an aggressive policy in favor of fossil fuels under Donald Trump's presidency. Therefore, our second hypothesis argues that the U.S. renewable energy sector did not experience such an increase in M&A deals because it was not directly confronted with the regulatory shock.

To address our hypotheses, we follow a methodology similar to that of Luo and Nazarov (2019). In their study, they investigate whether the provisions of the affordable care act are responsible for the wave of acquisitions in the U.S. health insurance industry. Specifically, we build different regression models with the number of deals per year as the dependent variable. We construct these models for two datasets, one for Western European bidders and one for U.S. bidders. First, we evaluate the impact of RED II alone using only this independent variable in our regression. Second, we add other independent variables from the neoclassical and behavioral frameworks to isolate the impact of the policy on the number of mergers and acquisitions.

Regarding the results of our first hypothesis, we find that the *Renewable Energy Directive (2018/2001/EU)* has increased the number of deals per year in Western Europe by 8, after controlling for variables from both the behavioral and neoclassical frameworks. We obtain a p-value smaller than 0.001 for *RED II*, as well as an R-squared value of 0.915. Therefore, we can consider our results sufficiently robust to confirm our first hypothesis and argue that RED II has increased the number of mergers and acquisitions in the renewable energy sector in Western Europe.

Regarding our second hypothesis, we find that the RED II has increased the number of transactions in the United States by 2.4, after controlling for the behavioral and neoclassical variables. The variable *RED II* has a p-value smaller than 0.01, and the R-squared of the model is 0.947, which gives credibility to our results. Therefore, we can conclude that RED II has had a limited impact on the number of deals in the United States, which reinforces our results for hypothesis 1. However, because of globalization, the United States is not isolated from what is happening in Europe. This certainly explains why RED II still has impacted the United States, albeit in a minor way.

Regarding Harford's (2005) theory in which industry shocks require high capital liquidity to become waves of mergers and acquisitions, we find contradictory results. Indeed, the variable *Tight capital* has a negative value for the United States, as expected, while it has a positive value for Western Europe. In both models, the variable *Tight capital* is statistically significant at the 0.001 level. Therefore, our study does not allow us to determine the role of capital liquidity in the increase in M&A activity.

Nonetheless, this paper is subject to several limitations, mainly because I used the means at my disposal, which were not always the most appropriate for mergers and acquisitions analysis.

The first limitations concern the size of the datasets and the data quality. First, the number of observations, approximatively 400 per dataset, is quite limited for statistical analysis. Second, the data for the neoclassical variables used by Luo and Nazarov (2019) in their study were not always available. For example, I had to divide each firm's operating cash flows by its total revenues to obtain the variable *Cash flow margin*, as it was not available as is. I also had to follow a similar procedure for the variable *scaled capex*. Furthermore, *Sales growth* and

Employee growth were not available as a percentage, as we needed, but rather as an integer. All of this is undoubtedly part of the reasons why our neoclassical variables are much less statistically significant than in Luo and Nazarov's (2019) study. Third, although the NEX is an index on the renewable energy sector, it does not perfectly reflect market valuation. Indeed, the index includes companies from all over the world and has a different classification than Bloomberg in what they consider to be part of the renewable energy sector. Last, the P/B ratio is for the entire world and not just Western Europe or the United States. Furthermore, it was computed, taking the average of its three sub-sectors.

Then, the first years of our dataset for Western Europe may include the effects of RED I in 2009, a factor we have not taken into account in our analysis. However, as we can see in Figure 8, we do not notice a significant fluctuation in the number of deals after the implementation of RED I, which leads us to believe that its impact is limited.

The last limitation concerns the interpretation of the variable *RED II*. Although we have controlled for factors suggested by both neoclassical and behavioral frameworks, the variable could still comprise other elements than the directive, which we have not taken into account in our analysis.

To conclude, although this paper faces several limitations, we still have robust results that prove that the *Renewable Energy Directive (2018/2001/EU)* has increased the number of M&A deals in Western Europe. This paper also provides leads for researchers who have access to more specialized M&A tools and who would be interested in doing the experiment again. In addition, it would have been interesting to assess the impact of the period between the beginning of the negotiation of the directive until its implementation. Finally, we have evaluated the impact of this policy on the number of mergers and acquisitions at the end of 2018 and during 2019. However, as member states must transpose RED II into their legislation by June 2021, it would also be interesting to measure the influence of this policy on the M&A market in the years to come.

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Appendices

Appendix 1: Number and Value of M&A Worldwide

Year	Number of deals	Value (bil. USD)
1998	15,711	2,272
1999	18,022	3,364
2000	23,806	3,087
2001	20,283	1,679
2002	17,096	1,083
2003	17,323	1,239
2004	19,647	2,003
2005	22,117	2,531
2006	25,333	3,708
2007	28,835	4,169
2008	23,301	2,444
2009	18,301	1,483
2010	20,957	2,121
2011	21,195	2,109
2012	20,463	1,977
2013	21,022	2,244
2014	25,106	3,81
2015	28,634	4,932
2016	29,359	4,204
2017	30,645	4,572
2018	32,262	4,383
2019	32,557	4,546
2020	29,917	3,846

Source: Bloomberg

Appendix 2: Comparison of Global M&A market to Global GDP

Year	Global current GDP (current bil. USD)	Global M&A volume (bil. USD)	Ratio M&A/ GDP (%)
1998	31,394	2,272	7,24%
1999	32,563	3,364	10,33%
2000	33,624	3,087	9,18%
2001	33,431	1,679	5,02%
2002	34,712	1,083	3,12%
2003	38,948	1,239	3,18%
2004	43,875	2,003	4,57%
2005	47,525	2,531	5,33%
2006	51,512	3,708	7,20%
2007	58,044	4,169	7,18%
2008	63,69	2,444	3,84%
2009	60,41	1,483	2,45%
2010	66,126	2,121	3,21%
2011	73,46	2,109	2,87%
2012	75,162	1,977	2,63%
2013	77,316	2,244	2,90%
2014	79,453	3,81	4,80%
2015	75,218	4,932	6,56%
2016	76,369	4,204	5,50%
2017	81,306	4,572	5,62%
2018	86,439	4,383	5,07%
2019	87,799	4,546	5,18%

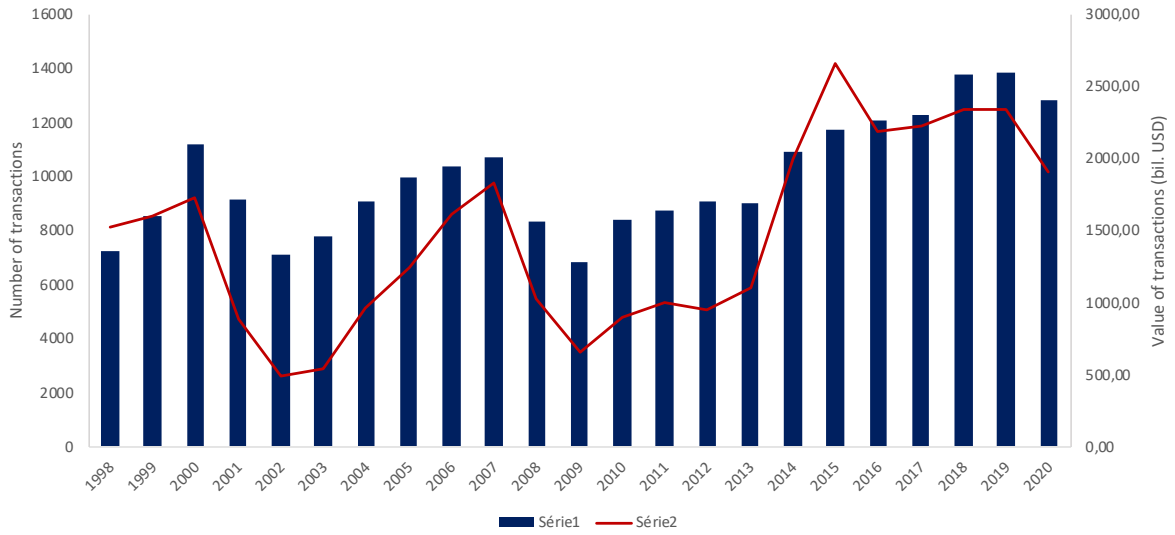
Source: World bank, Bloomberg

Appendix 3: Comparison of Global M&A market to world market capitalization

Year	World market capitalization (bil. USD)	Global M&A volume (bil. USD)	/ World market capital
1998	25,445	2,272	8,93%
1999	33,492	3,364	10,04%
2000	30,963	3,087	9,97%
2001	26,816	1,679	6,26%
2002	22,770	1,083	4,76%
2003	30,490	1,239	4,06%
2004	35,837	2,003	5,59%
2005	40,915	2,531	6,19%
2006	49,966	3,708	7,42%
2007	59,716	4,169	6,98%
2008	31,830	2,444	7,68%
2009	45,428	1,483	3,26%
2010	51,984	2,121	4,08%
2011	45,905	2,109	4,59%
2012	52,427	1,977	3,77%
2013	61,975	2,244	3,62%
2014	64,932	3,810	0,59%
2015	64,261	4,932	7,67%
2016	66,339	4,204	6,34%
2017	81,260	4,572	5,63%
2018	69,647	4,383	6,29%
2019	86,990	4,546	5,23%
2020	103,23	3,846	3,73%

Source: World Bank, Bloomberg

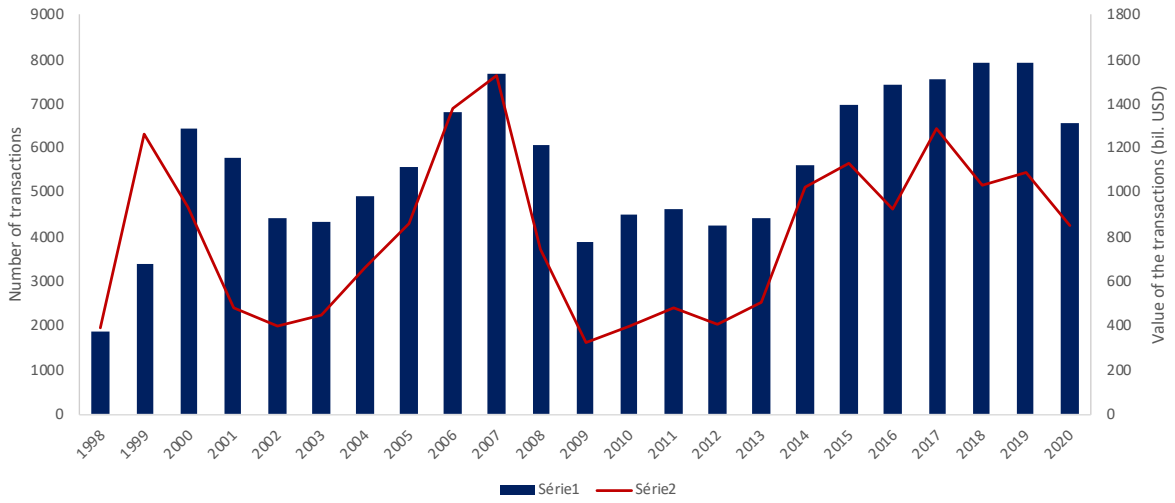
Appendix 4: Number and Value of M&A in North America



Year	Number of deals	Value (bil. USD)
1998	7,224	1,524
1999	8,534	1,602
2000	11,167	1,72
2001	9,152	884
2002	7,079	482
2003	7,782	535
2004	9,093	955
2005	9,924	1,242
2006	10,356	1,616
2007	10,71	1,828
2008	8,323	1,03
2009	6,851	658
2010	8,376	897
2011	8,725	1,003
2012	9,063	951
2013	8,984	1,098
2014	10,888	1,988
2015	11,743	2,662
2016	12,032	2,182
2017	12,241	2,224
2018	13,754	2,343
2019	13,851	2,342
2020	12,815	1,903

Source: Bloomberg

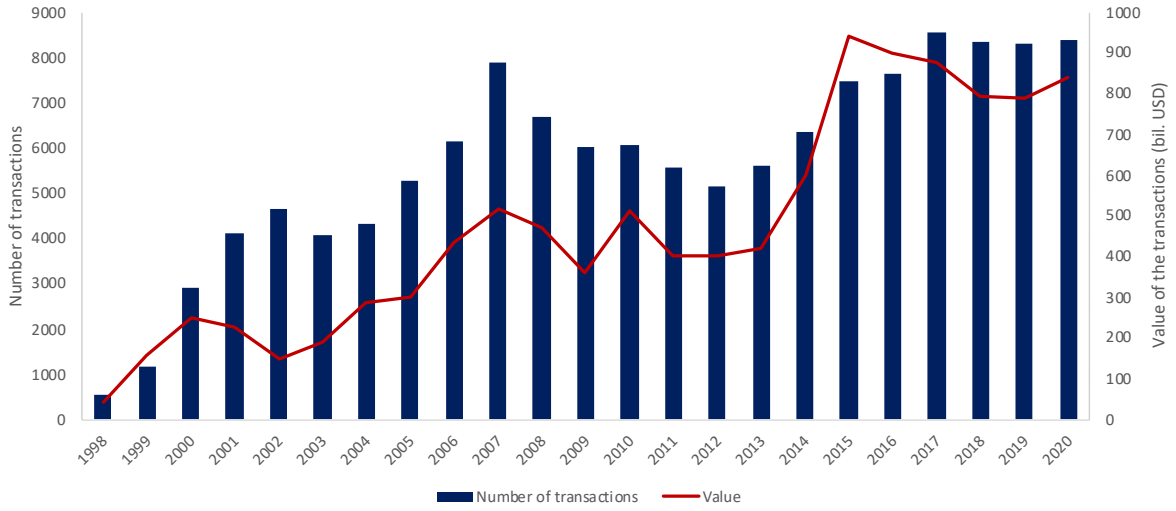
Appendix 5: Number and Value of M&A in Western Europe



Période	Nombre de deals	Volume ($ bn)
1998	1,881	389
1999	3,366	1,263
2000	6,418	929
2001	5,782	483
2002	4,432	399
2003	4,345	448
2004	4,922	659
2005	5,554	856
2006	6,817	1,374
2007	7,649	1,526
2008	6,045	741
2009	3,886	324
2010	4,499	396
2011	4,638	477
2012	4,244	405
2013	4,411	505
2014	5,624	1,019
2015	6,972	1,129
2016	7,403	925
2017	7,541	1,284
2018	7,903	1,034
2019	7,901	1,087
2020	6,567	851

Source: Bloomberg

Appendix 6: Number and Value of M&A in Asia-Pacific



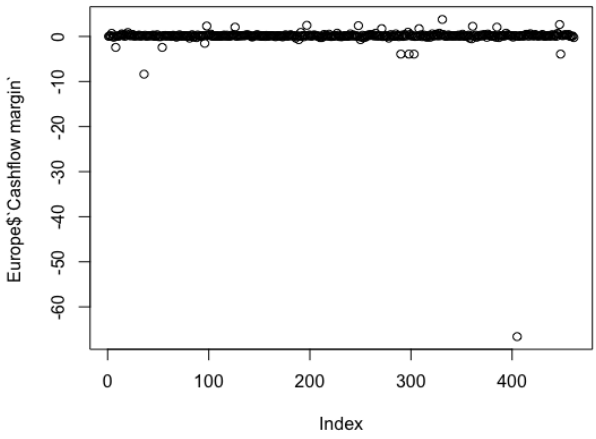
Période	Nombre de deals	Volume ($ bn)
1998	539	43
1999	1,169	157
2000	2,914	250
2001	4,101	228
2002	4,665	147
2003	4,081	189
2004	4,321	285
2005	5,271	299
2006	6,141	435
2007	7,891	514
2008	6,671	469
2009	6,017	359
2010	6,045	513
2011	5,544	400
2012	5,161	400
2013	5,588	421
2014	6,365	598
2015	7,459	940
2016	7,628	898
2017	8,526	875
2018	8,333	793
2019	8,311	787
2020	8379	841

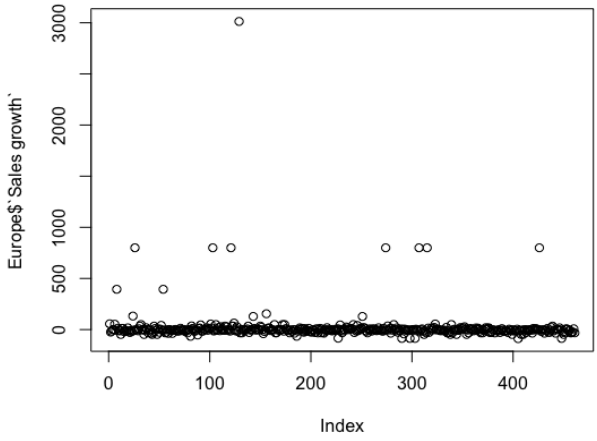
Source: Bloomberg

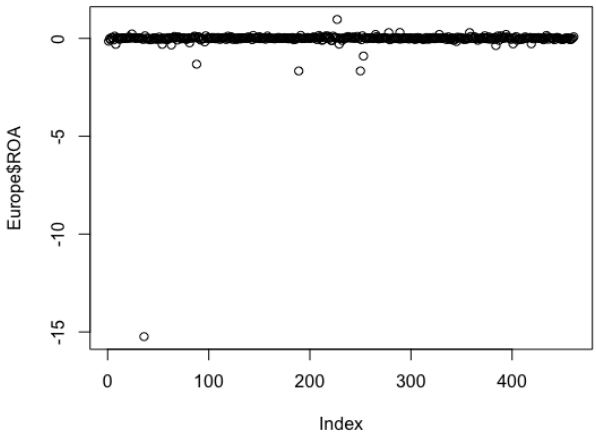
Appendix 7: Countries considered part of Western-Europe on Bloomberg

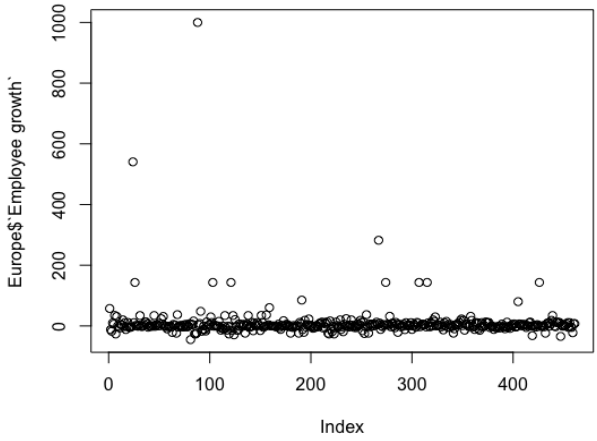
Country
Andorra
Austria
Belgium
Cyprus
Denmark
Faeroe Island
Finland
France
Germany
Gibraltar
Greece
Guernsey
Iceland
Ireland
Isle of Man
Italy
Jersey
Liechtenstein
Luxembourg
Malta
Monaco
Netherlands
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom

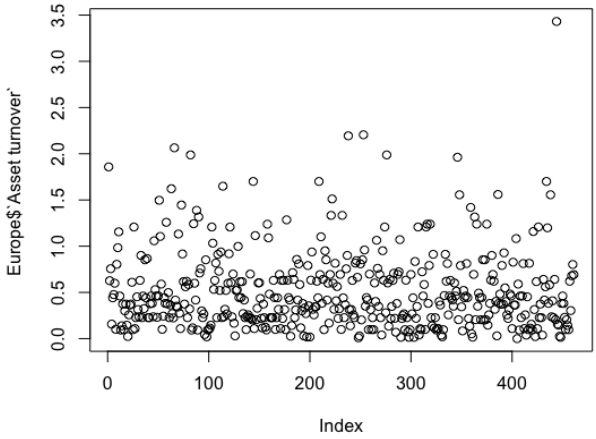
Appendix 8: Plots of the neoclassical variables before removing the outliers (Western Europe)

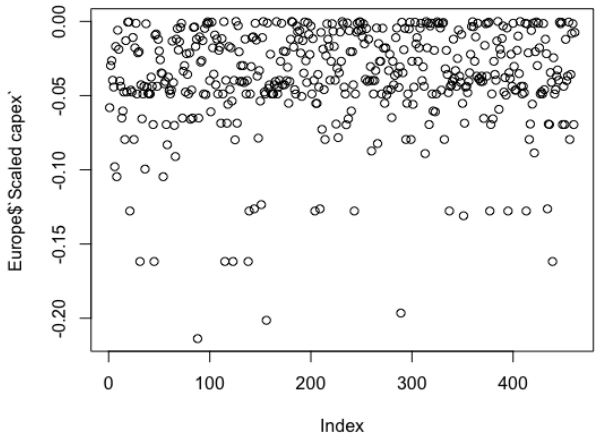




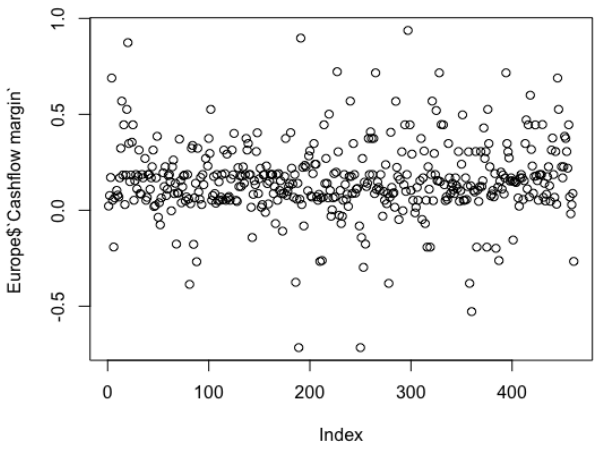


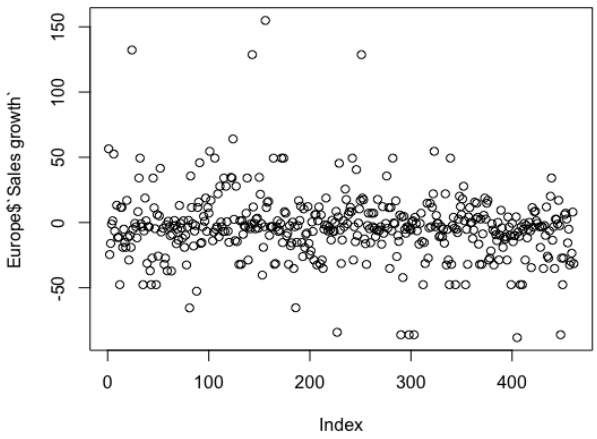


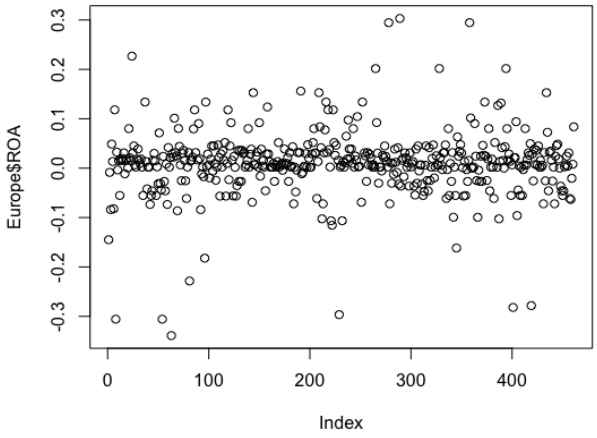


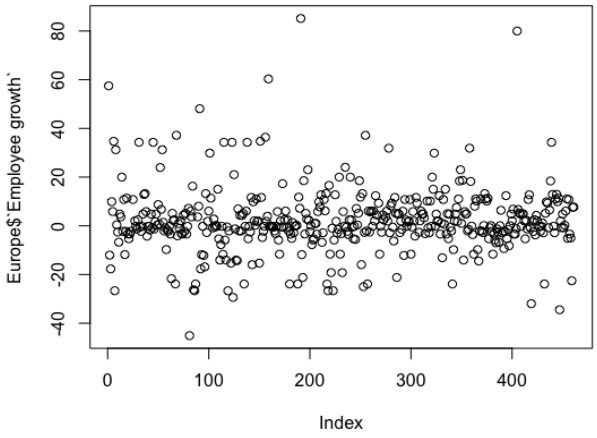


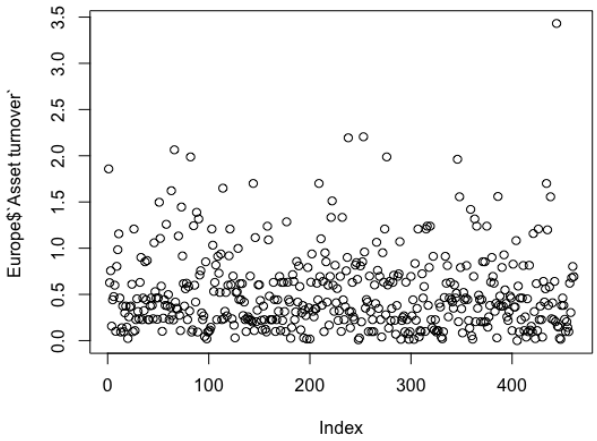
Appendix 9: Plots of the neoclassical variables after removing the outliers (Western Europe)

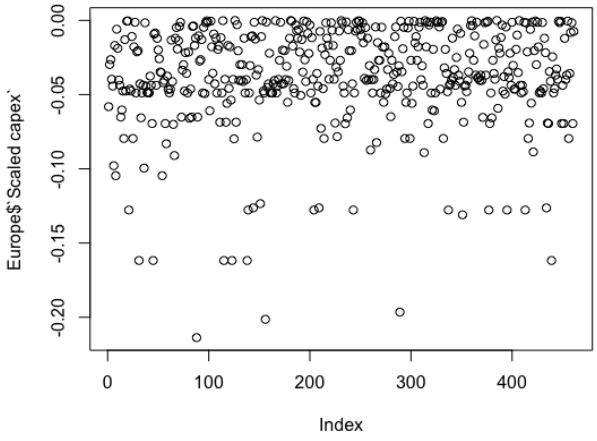




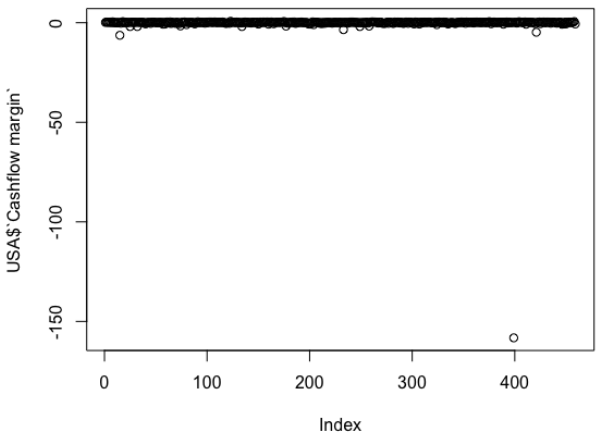


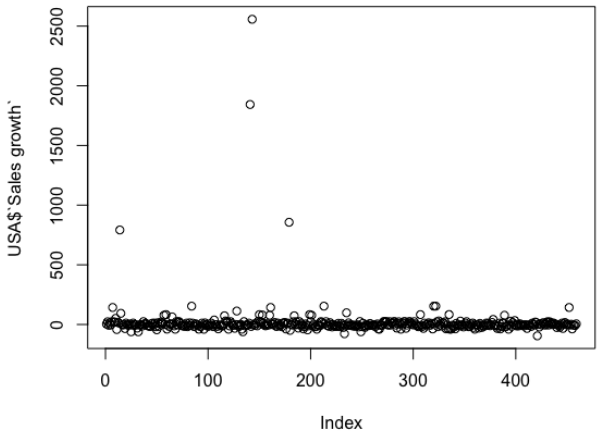


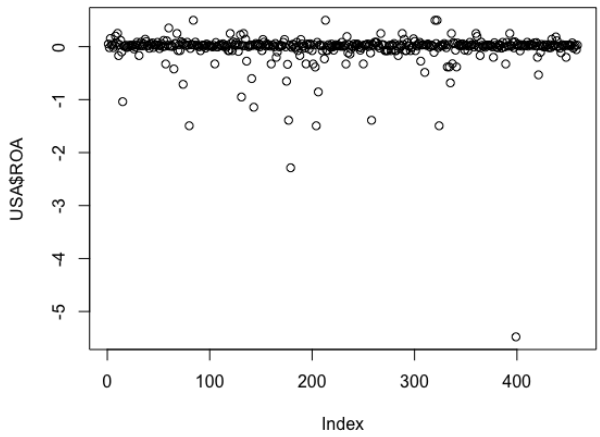


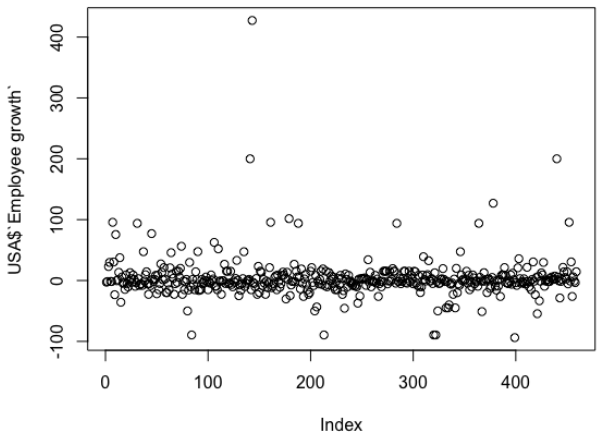


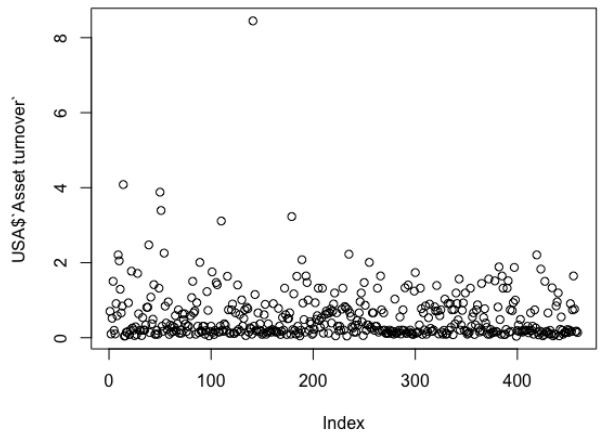
Appendix 10: Plots of the neoclassical variables before removing the outliers (United States)

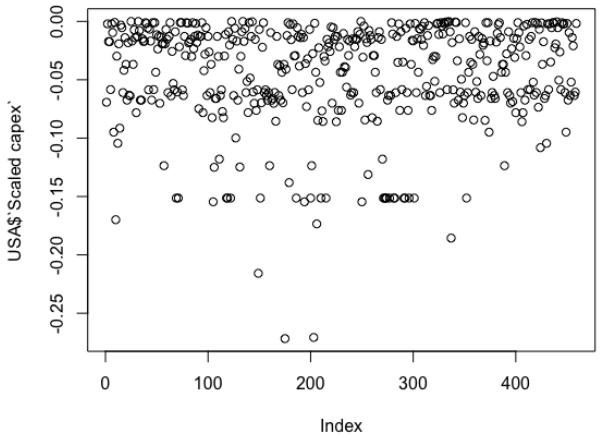




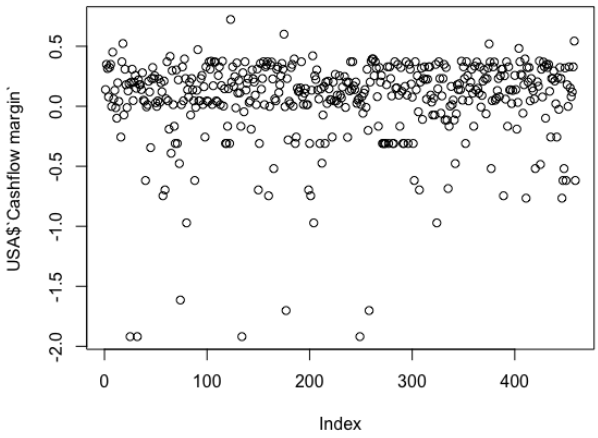


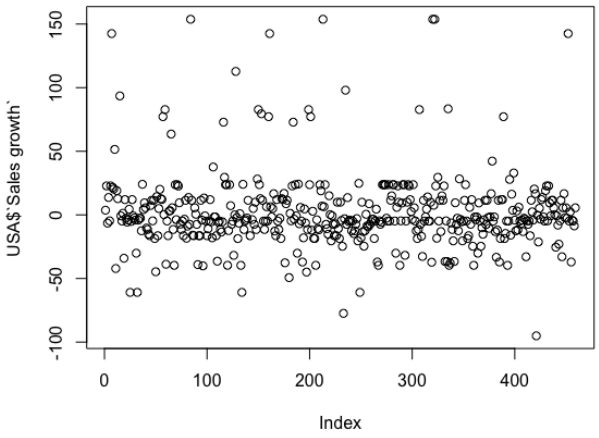


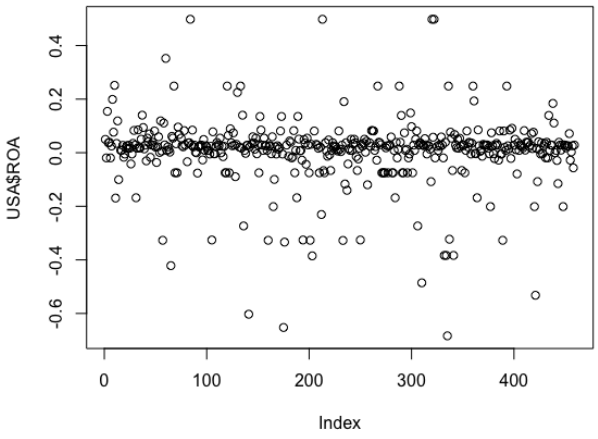


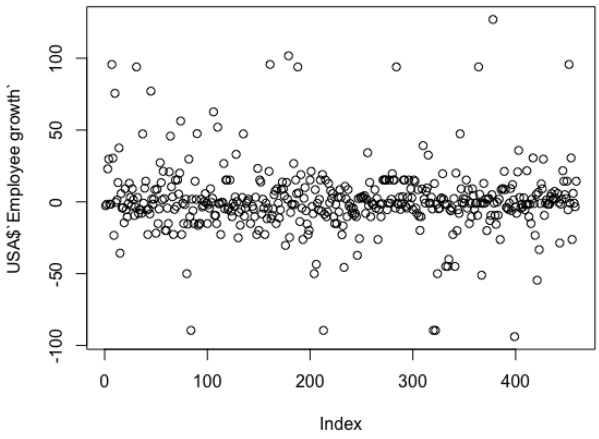


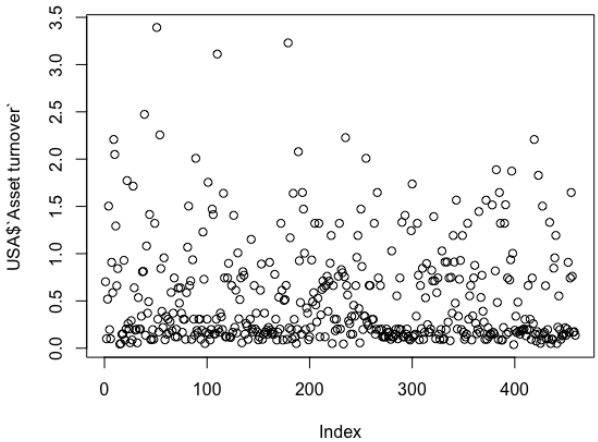
Appendix 11: Plots of the neoclassical variables after removing the outliers (United States)

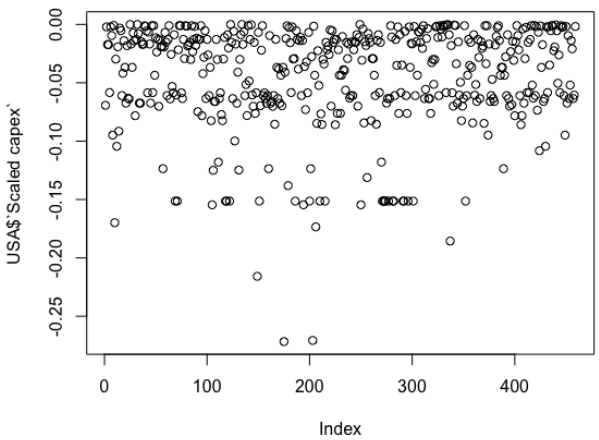












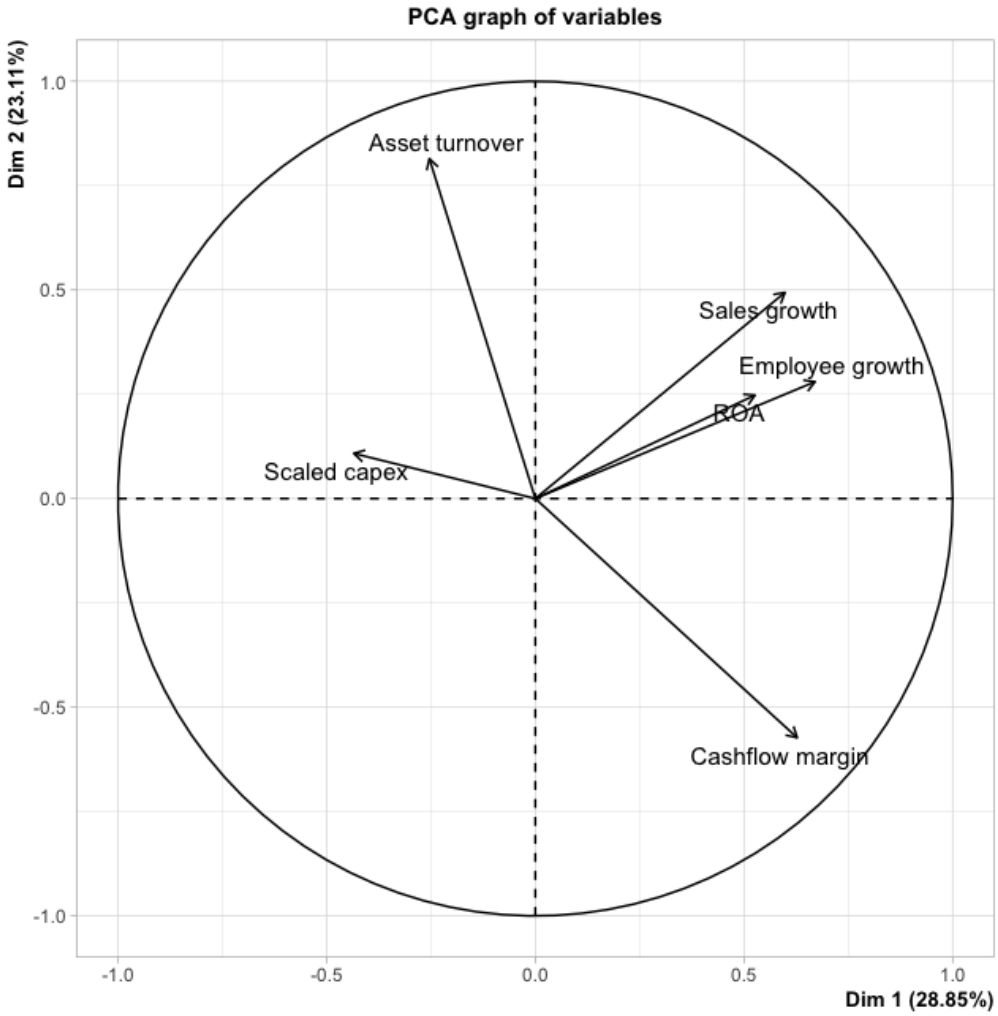
Appendix 12: Correlation of the independent variables (Western Europe)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Short-term interest rate (1)	1.000									
P/B ratio (2)	-0.206	1.000								
NEX returns (3)	-0.239	0.163	1.000							
NEX price variation (4)	0.752	-0.230	-0.345	1.000						
ROA (5)	0.103	0.017	-0.049	0.074	1.000					
Cash flow margin (6)	-0.073	0.116	0.069	-0.028	0.229	1.000				
Asset turnover (7)	-0.013	-0.065	0.094	-0.049	0.052	-0.575	1.000			
Scaled capex (8)	0.091	-0.051	-0.125	0.064	0.073	-0.257	0.009	1.000		
Employee growth (9)	-0.095	0.107	0.070	-0.038	0.199	0.139	-0.143	-0.063	1.000	
Sales growth (10)	0.035	0.137	-0.043	0.023	0.310	0.078	-0.055	0.029	0.410	1.000

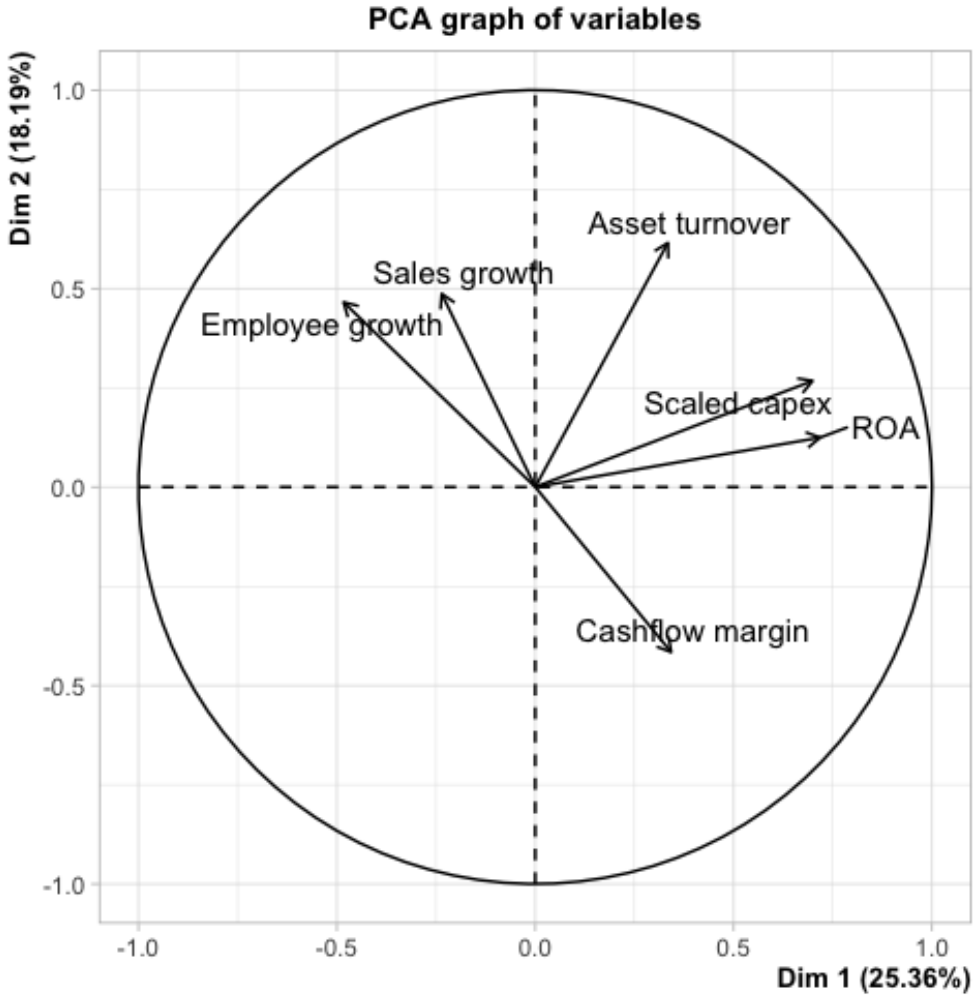
Appendix 13: Correlation of the independent variables (United States)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FDFD index (1)	1.000									
P/B ratio (2)	-0.357	1.000								
NEX returns (3)	-0.025	0.071	1.000							
NEX price variation (4)	-0.328	-0.142	-0.314	1.000						
ROA (5)	0.092	-0.064	0.004	0.007	1.000					
Cash flow margin (6)	0.048	0.053	-0.006	-0.151	0.221	1.000				
Asset turnover (7)	0.066	-0.196	0.035	0.094	0.292	-0.188	1.000			
Scaled capex (8)	0.031	0.026	0.004	0.001	0.179	-0.196	0.064	1.000		
Employee growth (9)	-0.007	0.053	0.012	-0.063	-0.137	-0.119	-0.137	-0.166	1.000	
Sales growth (10)	-0.021	0.075	-0.029	-0.019	-0.069	-0.031	-0.276	-0.143	0.423	1.000

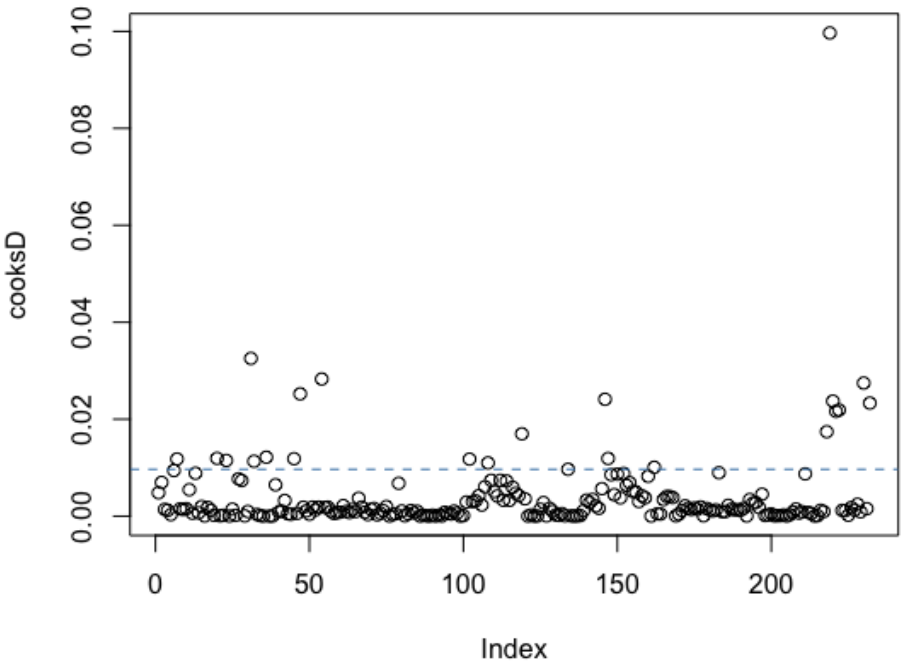
Appendix 14: Principal Component Analysis of the neoclassical variables (Western Europe)



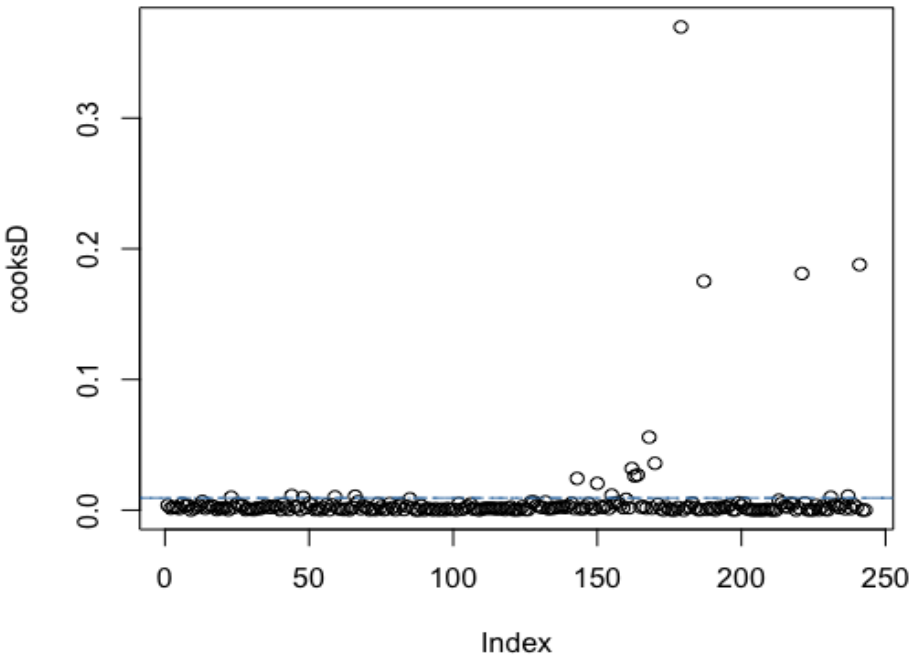
Appendix 15: Principal Component Analysis of the neoclassical variables (United States)



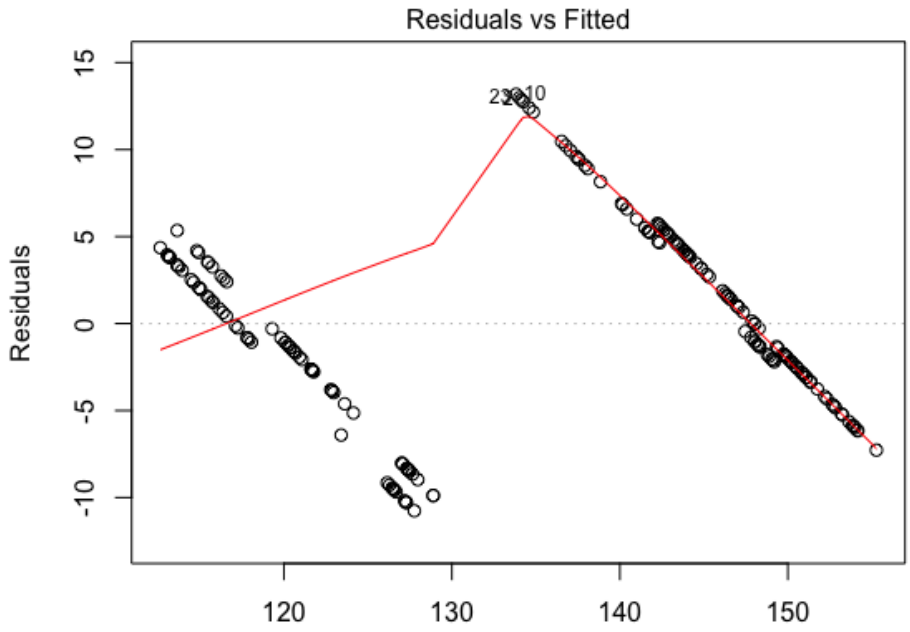
Appendix 16: Cooks' Distance of the fourth model (Western Europe)



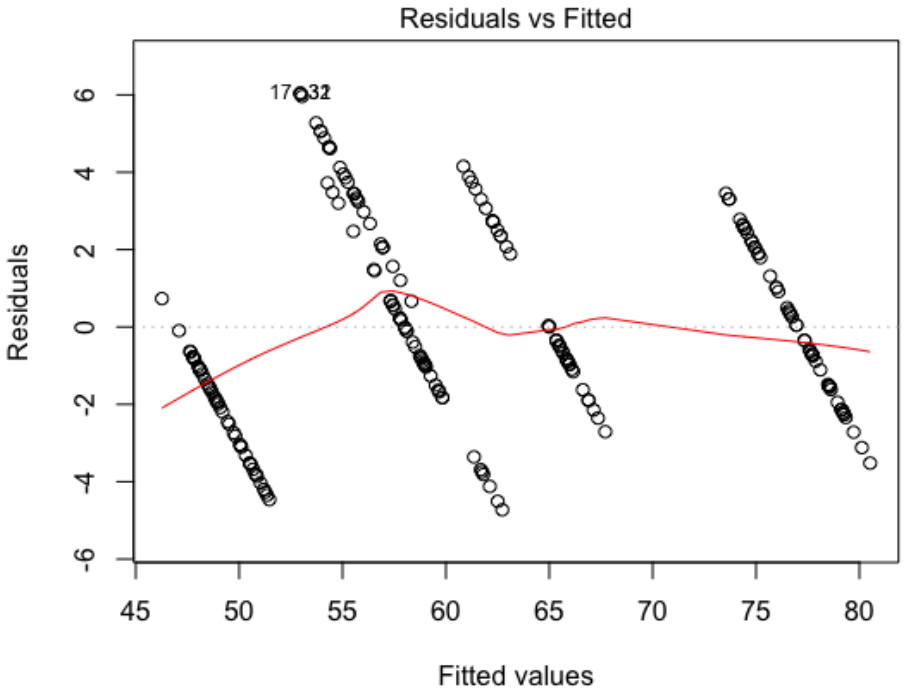
Appendix 17: Cooks' Distance of the fourth model (United States)



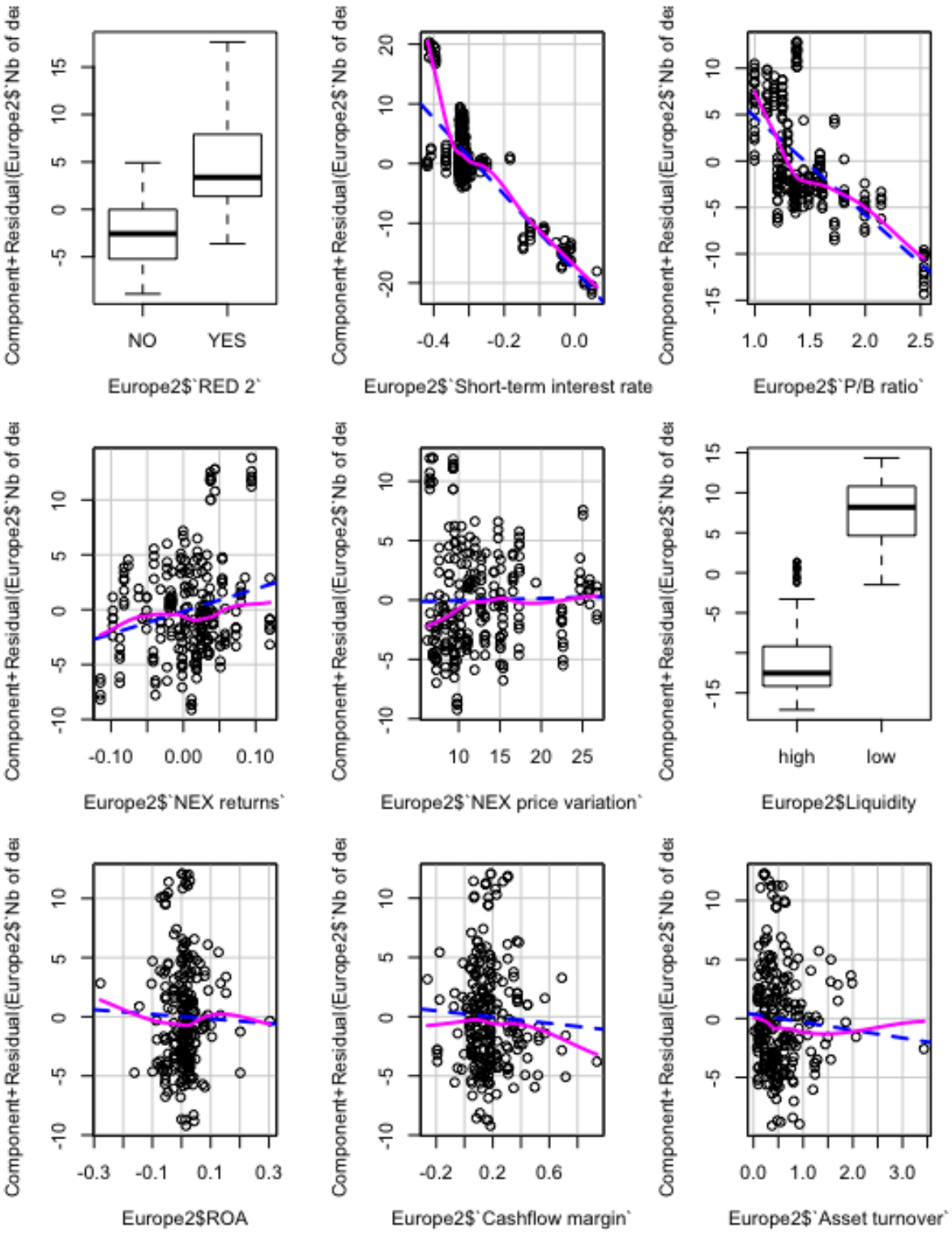
Appendix 18: Residuals vs fitted values of the fourth model (Western Europe)

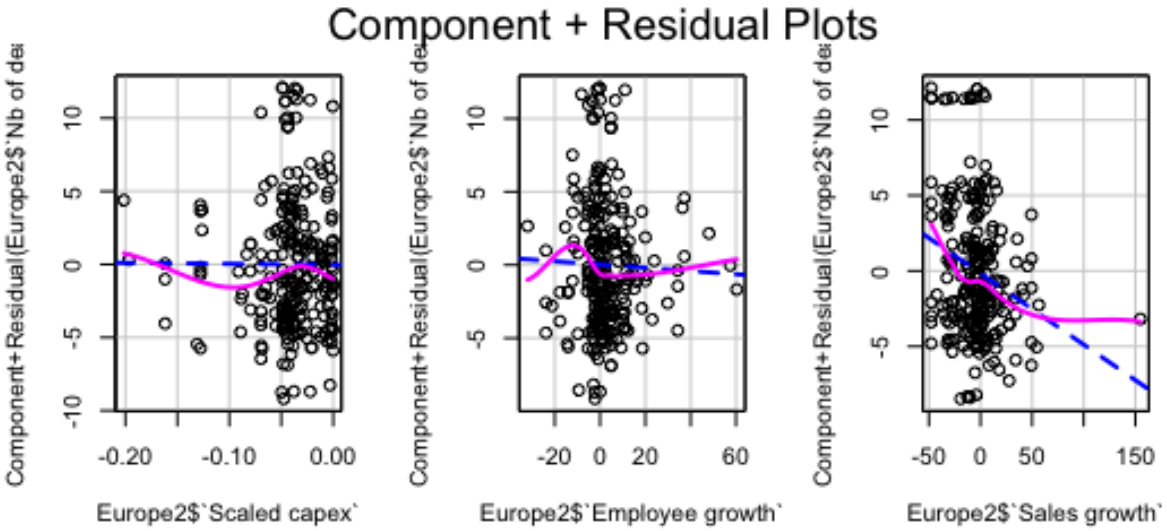


Appendix 19: Residuals vs fitted values of the fourth model (United States)

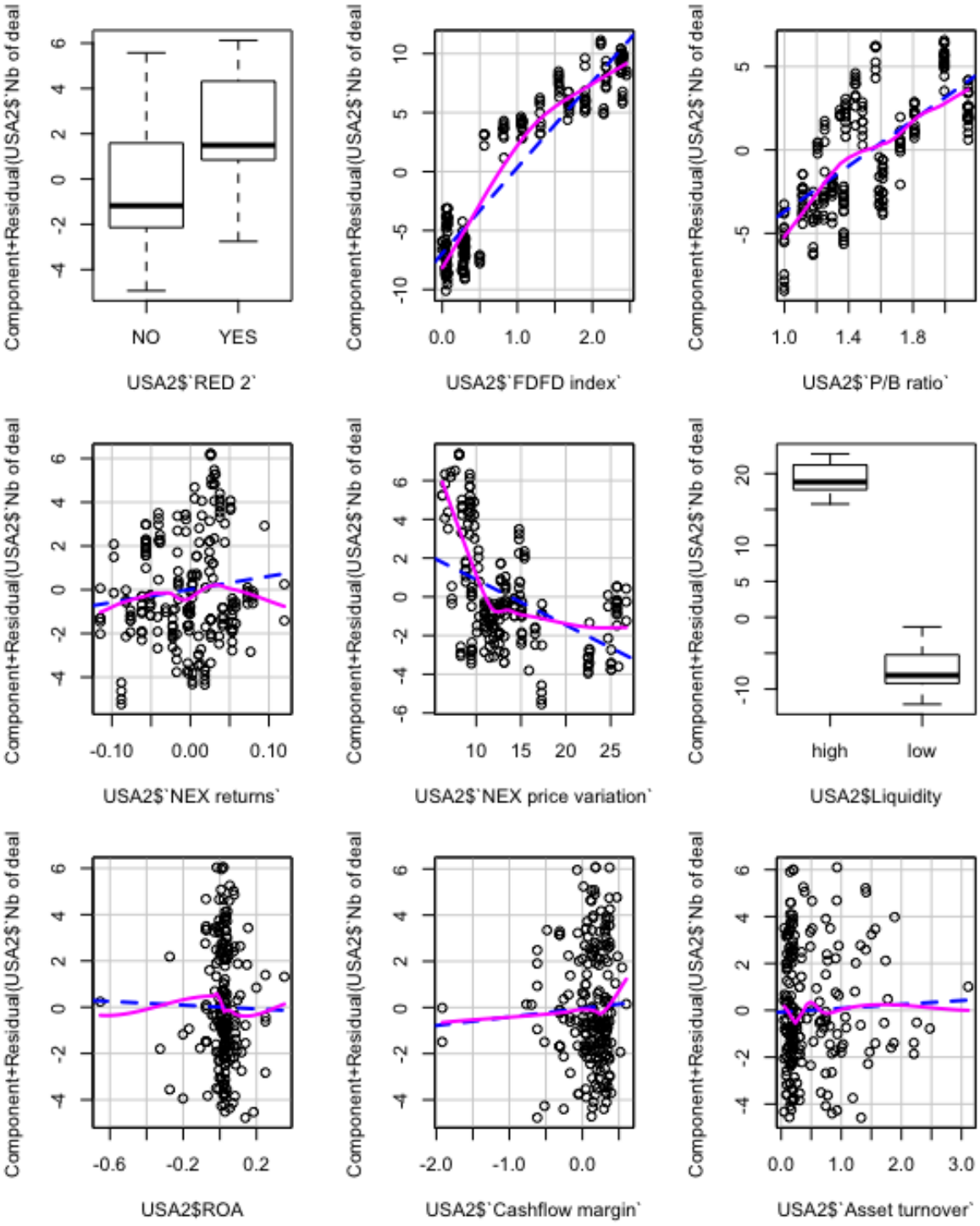


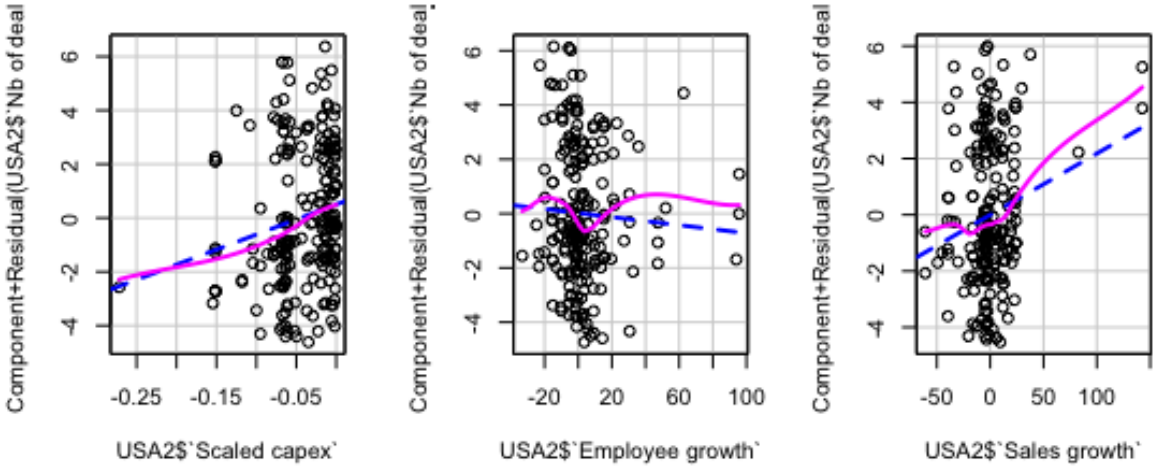
Appendix 20: Relationships between the dependent and independent variables (Western Europe)



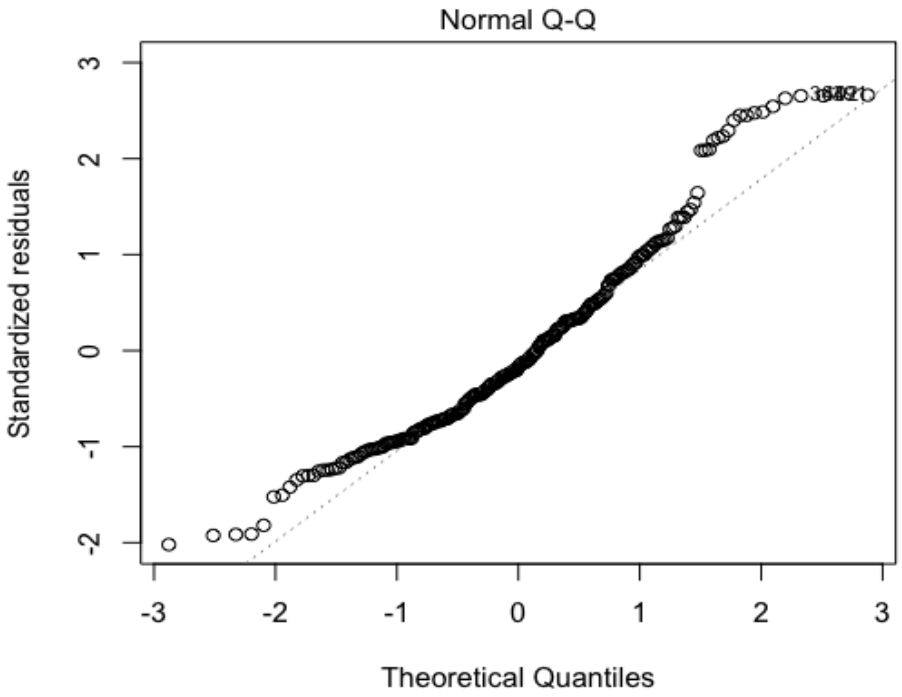

Component + Residual Plots
Component+Residual(Europe2$`Nb of de
-10
-5
0
5
10
-0.20
-0.10
0.00
Europe2$`Scaled capex`
Component+Residual(Europe2$`Nb of de
-5
0
5
10
-20
0
20
60
Europe2$`Employee growth`
Component+Residual(Europe2$`Nb of de
-5
0
5
10
-50
0
50
150
Europe2$`Sales growth`

Appendix 21: Relationships between the dependent and independent variables (United States)

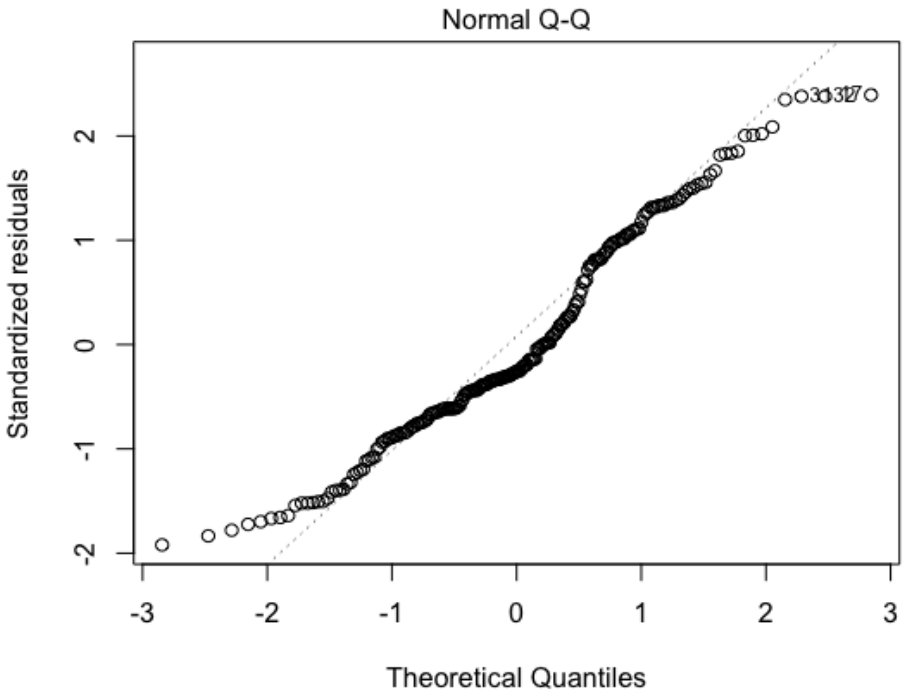



Component+Residual(USA2$`Nb of deal
-4
-2
0
2
4
6
-0.25
-0.15
-0.05
USA2$`Scaled capex`
Component+Residual(USA2$`Nb of deal
-20
20
60
100
USA2$`Employee growth`
Component+Residual(USA2$`Nb of deal
-50
0
50
100
USA2$`Sales growth`

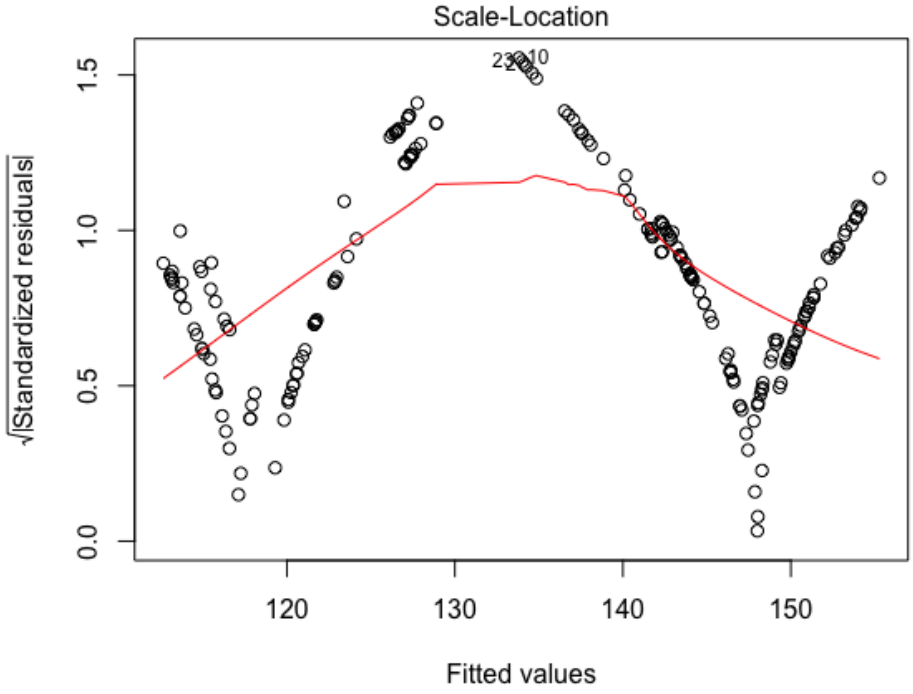
Appendix 22: QQ-plot (Western Europe)



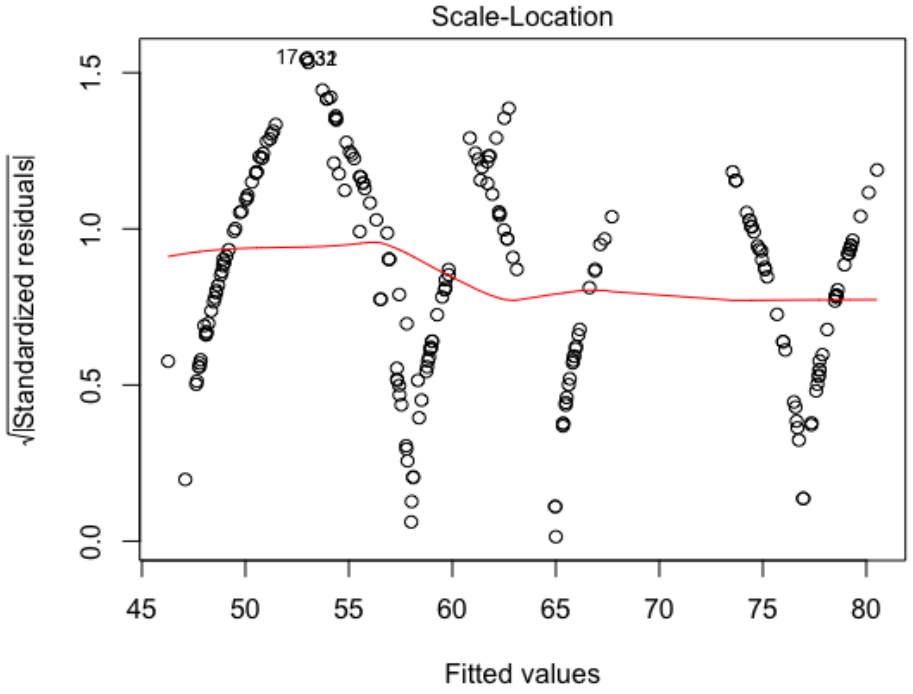
Appendix 23: QQ-plot (United States)



Appendix 24: Standard deviation of the residuals (Western Europe)



Appendix 25: Standard deviation of the residuals (United States)



Appendix 26: regressions results

Figure 12

Fourth regression model with outliers (United States)

```
Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                48.52979    2.78541  17.423  < 2e-16 ***
USA$`RED Z`YES              1.05247    0.85189   1.235   0.2179
USA$`FDFD index`            9.15999    0.59373  15.428  < 2e-16 ***
USA$`P/B ratio`            15.73442    1.31076  12.004  < 2e-16 ***
USA$`NEX returns`           2.21567    5.09088   0.435   0.6638
USA$`NEX price variation`  -0.23107    0.04913  -4.703 4.42e-06 ***
USA$ROA                     0.12856    2.35900   0.054   0.9566
USA$`Cashflow margin`       0.58129    0.73807   0.788   0.4317
USA$`Asset turnover`        0.29500    0.43957   0.671   0.5028
USA$`Scaled capex`         12.83254    5.66562   2.265   0.0244 *
USA$`Employee growth`       0.01169    0.01268   0.922   0.3575
USA$`Sales growth`          0.02662    0.01062   2.507   0.0129 *
factor(USA$Liquidity)low  -22.02334    0.78875 -27.922  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.425 on 230 degrees of freedom
  (198 observations deleted due to missingness)
Multiple R-squared:  0.9087,    Adjusted R-squared:  0.904
F-statistic: 190.8 on 12 and 230 DF,  p-value: < 2.2e-16
```

Figure 13

Robust standard errors of the fourth regression model with outliers (United States)

```
t test of coefficients:

                           Estimate Std. Error  t value  Pr(>|t|)
(Intercept)               48.529788   7.773465   6.2430 2.049e-09 ***
USA$`RED Z`YES             1.052471   0.931232   1.1302  0.259573
USA$`FDFD index`           9.159985   0.960897   9.5327 < 2.2e-16 ***
USA$`P/B ratio`           15.734418   3.794226   4.1469 4.742e-05 ***
USA$`NEX returns`          2.215672   4.597226   0.4820  0.630294
USA$`NEX price variation` -0.231066   0.047818  -4.8322 2.468e-06 ***
USA$ROA                    0.128557   2.456199   0.0523  0.958303
USA$`Cashflow margin`      0.581294   0.554372   1.0486  0.295480
USA$`Asset turnover`       0.295004   0.396457   0.7441  0.457574
USA$`Scaled capex`        12.832543   5.667875   2.2641  0.024501 *
USA$`Employee growth`      0.011688   0.020983   0.5570  0.578068
USA$`Sales growth`         0.026619   0.010084   2.6398  0.008863 **
factor(USA$Liquidity)low -22.023336   1.822062 -12.0870 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 14

Fourth regression model without outliers (United States)

```
Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                67.237049   3.388565  19.842  < 2e-16 ***
USA2$`RED 2`YES             2.439672   0.693542   3.518 0.000533 ***
USA2$`FDFD index`           7.277363   0.552772  13.165  < 2e-16 ***
USA2$`P/B ratio`            6.850112   1.648372   4.156 4.71e-05 ***
USA2$`NEX returns`          5.981717   4.091213   1.462 0.145205
USA2$`NEX price variation` -0.234596   0.038079  -6.161 3.61e-09 ***
USA2$Liquiditylow         -26.665693   0.814414 -32.742  < 2e-16 ***
USA2$ROA                   -0.405856   2.240579  -0.181 0.856433
USA2$`Cashflow margin`      0.372061   0.576459   0.645 0.519352
USA2$`Asset turnover`       0.164384   0.345009   0.476 0.634238
USA2$`Scaled capex`        11.185980   4.645894   2.408 0.016913 *
USA2$`Employee growth`     -0.007407   0.012132  -0.611 0.542186
USA2$`Sales growth`         0.021834   0.009372   2.330 0.020771 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.564 on 211 degrees of freedom
  (198 observations deleted due to missingness)
Multiple R-squared:  0.9468,    Adjusted R-squared:  0.9438
F-statistic: 312.8 on 12 and 211 DF,  p-value: < 2.2e-16
```

Figure 15

Robust standard errors of the fourth regression model without outliers (United States)

```
                           Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)               67.2370494   2.9099446  23.1060 < 2.2e-16 ***
USA2$`RED 2`YES            2.4396723   0.7416260   3.2896  0.001176 **
USA2$`FDFD index`          7.2773627   0.5358592  13.5807 < 2.2e-16 ***
USA2$`P/B ratio`           6.8501122   1.5088569   4.5399 9.451e-06 ***
USA2$`NEX returns`         5.9817166   2.9407291   2.0341  0.043194 *
USA2$`NEX price variation` -0.2345958   0.0348896  -6.7240 1.628e-10 ***
USA2$Liquiditylow         -26.6656930   0.6867868 -38.8267 < 2.2e-16 ***
USA2$ROA                   -0.4058556   2.0839871  -0.1947  0.845776
USA2$`Cashflow margin`      0.3720614   0.4696181   0.7923  0.429097
USA2$`Asset turnover`       0.1643836   0.3196899   0.5142  0.607652
USA2$`Scaled capex`        11.1859801   4.6445555   2.4084  0.016882 *
USA2$`Employee growth`     -0.0074069   0.0106115  -0.6980  0.485942
USA2$`Sales growth`         0.0218335   0.0075756   2.8821  0.004359 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 16

Fourth regression model with outliers (Western Europe)

```
Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                     118.356383   4.435971  26.681  < 2e-16 ***
Europe$`RED 2`YES                 9.289652   0.868707  10.694  < 2e-16 ***
Europe$`Short-term interest rate` -61.203640   6.262849  -9.772  < 2e-16 ***
Europe$`P/B ratio`                -10.794025   1.619577  -6.665 1.62e-10 ***
Europe$`NEX returns`               20.697871   7.328213   2.824  0.00511 **
Europe$`NEX price variation`       -0.006892   0.075517  -0.091  0.92736
Europe$ROA                         -1.572404   5.487807  -0.287  0.77471
Europe$`Cashflow margin`           -1.152224   2.032744  -0.567  0.57132
Europe$`Asset turnover`            -0.765178   0.837689  -0.913  0.36187
Europe$`Scaled capex`               1.448573   9.541116   0.152  0.87945
Europe$`Employee growth`           -0.003586   0.028854  -0.124  0.90118
Europe$`Sales growth`              -0.035680   0.014981  -2.382  0.01796 *
factor(Europe$Liquidity)low        16.938323   0.886116  19.115  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5.083 on 256 degrees of freedom
  (156 observations deleted due to missingness)
Multiple R-squared:  0.8968,    Adjusted R-squared:  0.892
F-statistic: 185.4 on 12 and 256 DF,  p-value: < 2.2e-16
```

Figure 17

Robust standard errors of the fourth regression model with outliers (Western Europe)

```
t test of coefficients:

                                   Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)                     118.3563831   2.9885631  39.6031 < 2.2e-16 ***
Europe$`RED 2`YES                 9.2896516   0.9719340   9.5579 < 2.2e-16 ***
Europe$`Short-term interest rate` -61.2036399   4.3713264 -14.0012 < 2.2e-16 ***
Europe$`P/B ratio`                -10.7940249   1.0031238 -10.7604 < 2.2e-16 ***
Europe$`NEX returns`               20.6978712   6.0410273   3.4262 0.0007128 ***
Europe$`NEX price variation`       -0.0068918   0.0567477  -0.1214 0.9034329
Europe$ROA                         -1.5724041   6.3163955  -0.2489 0.8036067
Europe$`Cashflow margin`           -1.1522243   2.2461532  -0.5130 0.6084100
Europe$`Asset turnover`            -0.7651779   0.7525541  -1.0168 0.3102206
Europe$`Scaled capex`               1.4485734   8.3065956   0.1744 0.8616981
Europe$`Employee growth`           -0.0035862   0.0252395  -0.1421 0.8871224
Europe$`Sales growth`              -0.0356802   0.0141333  -2.5246 0.0121896 *
factor(Europe$Liquidity)low        16.9383225   0.9295636  18.2218 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 18

Fourth regression model without outliers (Western Europe)

```
Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    115.99460    4.10340  28.268  < 2e-16 ***
Europe2$`RED 2`YES`              8.00597    0.82778   9.672  < 2e-16 ***
Europe2$`Short-term interest rate` -63.98193    5.76711 -11.094  < 2e-16 ***
Europe2$`P/B ratio`            -10.53516    1.48460  -7.096 1.47e-11 ***
Europe2$`NEX returns`           20.51182    6.84670   2.996  0.00303 **
Europe2$`NEX price variation`    0.01818    0.07020   0.259  0.79583
Europe2$Liquiditylow            18.34007    0.83682  21.916  < 2e-16 ***
Europe2$ROA                     -1.93848    6.02265  -0.322  0.74784
Europe2$`Cashflow margin`       -1.32191    2.25393  -0.586  0.55810
Europe2$`Asset turnover`        -0.66765    0.83211  -0.802  0.42315
Europe2$`Scaled capex`          -0.64850    9.02490  -0.072  0.94278
Europe2$`Employee growth`       -0.01106    0.02820  -0.392  0.69518
Europe2$`Sales growth`          -0.04710    0.01443  -3.265  0.00126 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4.611 on 237 degrees of freedom
  (156 observations deleted due to missingness)
Multiple R-squared:  0.9153,    Adjusted R-squared:  0.911
F-statistic: 213.4 on 12 and 237 DF,  p-value: < 2.2e-16
```

Figure 19

Robust standard errors of the fourth regression model without outliers (Western Europe)

```
t test of coefficients:

                                Estimate Std. Error  t value  Pr(>|t|)
(Intercept)                    115.994603   2.721568  42.6205 < 2.2e-16 ***
Europe2$`RED 2`YES               8.005973   1.041222   7.6890  3.94e-13 ***
Europe2$`Short-term interest rate` -63.981932   4.115760 -15.5456 < 2.2e-16 ***
Europe2$`P/B ratio`            -10.535157   0.968070 -10.8826 < 2.2e-16 ***
Europe2$`NEX returns`           20.511817   5.529216   3.7097 0.0002585 ***
Europe2$`NEX price variation`    0.018184   0.051188   0.3552 0.7227256
Europe2$Liquiditylow            18.340070   0.931529  19.6881 < 2.2e-16 ***
Europe2$ROA                     -1.938485   5.031109  -0.3853 0.7003610
Europe2$`Cashflow margin`       -1.321909   1.755871  -0.7529 0.4522868
Europe2$`Asset turnover`        -0.667653   0.633316  -1.0542 0.2928569
Europe2$`Scaled capex`          -0.648500   7.740164  -0.0838 0.9332991
Europe2$`Employee growth`       -0.011063   0.023309  -0.4746 0.6355006
Europe2$`Sales growth`          -0.047102   0.015963  -2.9507 0.0034880 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

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