Empirical Findings of Mergers and Acquisitions in the European Electricity and Gas Industry after the 5th Wave

Supervisor: Prof. dr. A.H.F. Verboven
Student: Huiting Fu
Student Number: s996797
Study Program: International Management Master Program-Finance track
Tilburg University, March 15, 2011
Abstract

In this thesis, I research the phenomenon of the M&A raised after the 5th wave in European electricity and gas industry. I want to find out what the results are after mergers and acquisitions among European firms in electricity and gas industry. Moreover, this research expands its investigation by searching the relevant factors affecting the bidder companies’ valuation change. The data collected for the research is from the bidder’s takeover premium. The main tasks of this research are (1) to use the event study analysis and statistical method to observe the influence to the valuation change of the bidder companies after the 5th merger wave; (2) to implement the linear regression analysis to find out the factors affecting the cumulative abnormal returns around the M&A event time (CAR) after the 5th wave.
## Contents

Chapter 1 Introduction ...........................................................................................................5
  1.1 Introduction ..................................................................................................................5
  1.2 Research questions ......................................................................................................5
  1.3 Methodology ................................................................................................................5
  1.4 Structure of the thesis .................................................................................................6

Chapter 2 Literature Review ..................................................................................................7
  2.1 Review of M&A activity development (6 waves) .........................................................7
  2.2 Classification of M&A ...............................................................................................9
  2.3 Specific characteristics of the M&A in electricity and gas sector .............................10
    2.3.1 Restructuring ........................................................................................................12
    2.3.2 Competition ..........................................................................................................13
    2.3.3 Regulation ............................................................................................................14
    2.3.4 Privatization .........................................................................................................15

Chapter 3 The Opportunities and Barriers of the M&A after the 5th Wave .......................16
  3.1 Opportunities .............................................................................................................16
  3.2 Problem and barriers ..................................................................................................18
  3.3 Research questions and hypothesis ..........................................................................19

Chapter 4 Data and Methodology ......................................................................................22
  4.1 Data collection ............................................................................................................22
    4.1.1 Collecting the data of the bidder companies .........................................................22
    4.1.2 Collecting the data of the stock price of the bidder companies .........................23
  4.2 Research methodologies – Event Study .......................................................................24
    4.2.1 Identify the event .................................................................................................24
    4.2.2 Calculate the normal returns ..............................................................................25
    4.2.3 Calculate and analyze the abnormal returns ......................................................26
  4.3 Research methodologies – Regression Analysis .........................................................29
    4.3.1 Observed factors .................................................................................................29
    4.3.2 To formulate the relationship between CAR and the factors ............................30
    4.3.3 Regression Analysis by SPSS ...........................................................................31

Chapter 5 Summary and Conclusions ................................................................................41
  5.1 Literature review, opportunities and barriers ............................................................41
5.2 Event Study .................................................................................................................. 41
5.3 Regression Analysis ...................................................................................................... 43
5.4 Conclusions .................................................................................................................. 45
REFERENCE ...................................................................................................................... 46
Chapter 1 Introduction

1.1 Introduction

Currently, restructuring in electricity and gas sector in European countries is a hot issue. The first merger and acquisition occurred in this area in Europe is in the United Kingdom in 1989, and the change was driven by the large differences in electricity tariffs across regions [8]. Recently, there are a lot of opportunities of investments in power industry in many European countries provided by the governments. These investments used to be only state-owned monopolies, but the ongoing restructuring moves away the monopolies and brings more competence.

So far, after the 5th wave (see section 2.1 for the definition), many major European energy companies, such as E.ON and RWE, have announced that Eastern Europe will be their next target where they will expand towards. This phenomenon indicates that not only the Western Europe has consolidated to the point where the number of the potential acquisition target is reduced, but also that Central Europe is a better fit for their current long-term strategies [9]. Moreover, this trend is likely to accelerate in the near future. Therefore, studying the M&A activities in the European energy area and its influence is an interesting subject.

1.2 Research questions

My thesis will study what the effects of the mergers and acquisitions among the European companies in electricity and gas industry are after the 5th wave, and I focus on two of the sub-questions:

(1) Is the value of the observed bidder companies in European electricity and gas industry significantly affected by the mergers and acquisitions?
(2) What would be the main factors that affect the valuation change of the bidder companies and what the strength of the influence by these factors are?

1.3 Methodology

In my thesis, I will use event analysis to study the first research question. This method – event study, has been introduced in Tilburg University as the lecture note for the course Empirical Finance and Investment Cases by Frank de Jong [1]. Event study is an important tool in finance. When a significant event happened on a company (such as M&A in our case), it is difficult to measure the valuation change of a company. In
empirical finance, the impact of the significant event can be measured by the change in the stock price of the company around the event time. The measuring approach is based on the statistical tests of the abnormal returns. For more details about the event study methodology, see chapter 4 in this thesis.

Assuming that there is a valuation change of the companies influenced by the M&A activities, then what factors would actually influence the valuation change? I will use regression analysis to study the second research question. Regression Analysis is, based on collecting massive observed data, using statistical method to formulate a regression relationship function between the dependent variable and the independent variables [31]. If the function contains only one independent variable, then the regression analysis is called simple regression analysis; if the function contains multiple independent variables, it is called multiple regression analysis. In my thesis, I will observe three factors, so I will use multiple regression analysis.

1.4 Structure of the thesis

The remainder of this thesis is structured as the following. The next chapter is literature review, from the overview of the process of M&A in Europe to the classification of merger and acquisition. Besides, specific characteristics of the M&A in electricity and gas sector will be illustrated. In chapter 3, I will focus on the discussion about the opportunities and the barriers to the M&A activities after the 5th wave, explaining the main trend of the activities and the positive factors that affected the mergers and acquisitions in the electricity and gas sector as well as the negative factors. In the fourth chapter, the data sampling procedure and the research methodology will be demonstrated and explained. With the collected data, I will perform the event study and the regression analysis. In chapter 5, I will state the research conclusion, as well as what the further research questions of my thesis would be.
Chapter 2 Literature Review

Extensive researches have verified that mergers and acquisitions (M&A) come in waves. Currently, the world is experiencing the 6th wave. In my thesis I will study the impact after the 5th wave which takes place mainly in Europe and the US [10]. The changes occurred after the 5th wave has made a huge impact in many industries, including the power area in Europe. My research focuses on finding out the impact of the mergers and acquisitions among the European companies in electricity and gas industry after the 5th wave, and I will first introduce the M&A wave history in the following section.

2.1 Review of M&A activity development (6 waves)

Waves are defined as a phenomenon that the activities occur in bursts interspersed with relative inactivity [11]. Although this description is not enough to acknowledge precisely a “wave”, but up until now there is no accurate definition or exact measurement to capture wave phenomenon that is widely accepted. There are still a small number of researchers who research on recognizing or measuring the M&A waves. Authors use direct observation to examine bursts on the M&A patterns as a “consensus” on their M&A related studies. Cools and van de Laar [12] present an overall picture of depicting the consequence of the M&A waves which is showed in Figure 1 M&A Waves Overview.

As you can see from Figure 1 M&A Waves Overview, the M&A waves since 1897, based on the number of mergers, are executed with different levels of peaks and troughs. So
far, there have been six waves indicated and examined where most of the observations took place in the US since it has run a long way of the M&A. Then it is followed by UK and recently by Continental Europe.

**The First Wave (1893 to 1904):** The first wave happened in the US in a period of economic expansion following a decade of stagnation. A particular characteristic of the first wave is the horizontal merger performed by the giant companies. During that time, this kind of merger has a name of horizontal consolidation. The wave during this time is described as merger for monopoly.

**The Second wave (1919 to 1929):** The second wave also occurred in the US and it was accompanied by significant economic growth and stock market boom. The wave is mainly held by oligopolistic structure purpose by the large enterprises. This wave was ended because of the 1929 Crash and the Great Depression.

**The Third Wave (1955 to 1969-1973):** This wave experienced the concept of conglomerate which took hold of US companies’ management. The scale of all the mergers was not large. Some of them were relatively large acquires but they were unrelated mergers with purpose of achieving growth through diversification. However, companies could not get the expected benefits from the diversification under the crashed conglomerate stocks.

UK has much longer history for M&A activities compared to any other European countries started from 1960s since it has several similarities in terms of company structures, characteristics and regulations to the US. This wave occurred in the UK is characterized by horizontal merger followed by some signs of conglomerate merger in the latter years. This is different from the US M&A movements in the same period, however, the movements in the UK had somewhat triggered M&A movements in Europe.

**The Fourth Wave (1974-1980 to 1989):** The fourth wave includes acquisitions and divestitures. Many US companies made simultaneously acquisitions and divestitures to expand the competitive advantage and to exit those which would limit their competitive advantage. The wave is characterized by many developments like junk bonds, hostile takeovers, financing and steadily increasing volume and size of LBOs.

Along this wave, UK had the same characteristics as in the US. Continental Europe had been affected by the move also. Although there is no certainty, some literature points out that the M&A activities in continental Europe have increased since 1984 with much smaller size and volume.

**The Fifth Wave (1993-2000):** This wave started in the US area. During this wave, unprecedented size companies were created on the assumption that size does matter.
High stock price simultaneously affected the companies to keep conducting deals to maintain their competition level. Another dramatic characteristic is the global view of competition to create distinguished competitive advantage which led to the growth of the size and volume of the cross border takeovers.

This pattern of movements affected not only the US but also the European countries. Compared to the US, the number and the size of the deals in the continental Europe have raised greatly with the reason of the increasing number of intra-European countries deals and the stability of transatlantic deals. At the same time, euro currency has a big impact on the wave because it reduces currency risk and home bias investments.

The Sixth Wave (2002-2010): This wave is introduced by Martin Lipton [13], who believes the new merger activities which has increased from 1.2 billion US$ in 2002 to 3.4 billion US$ by the end of 2006. He pointed out that the most typical features of the wave were government support, globalization factors, low-interest financing, hedge fund and the growth of private equity funds.

Although there is no direct evidence to show the sixth wave is global, the M&A activities occurred in many markets in the world, especially in the European markets. Some researchers believe that the fifth wave is actually the first international wave because of the fast growing cross-border takeover in that period [14]. The increasing number of hostile takeovers, which prefers immediate acquisitions rather than the changes of the structure of capital markets, is caused by the stability of economic conditions and management strategy [15].

2.2 Classification of M&A

There are several ways in which a firm can be acquired by another firm.

Merger and Consolidation
In a merger the target firm is absorbed by the acquiring firm, and becomes part of the acquiring firm. After the merger, the target firm ceases to exist as a separate business entity. Consolidation is very similar to merger. However, the difference between merger and consolidation is that in a consolidation, both the acquiring firm and the acquired firm terminate their previous legal existence and a new firm will be created by both the target and bidding firm. In a word, merger and consolidation result in combinations of the assets and liabilities of acquired and acquiring firms.

Acquisition of Stock
An acquisition, also known as a takeover, is the buying of one company (the ‘target’) by another. An acquisition may be friendly or hostile. Acquisition of stock is the way
to purchase the firm’s voting stock in exchange for cash, shares of stock, or other securities. Sometimes the acquisitions are finished by the private offer between the managements of one firm and the other. Sometimes, it can also be used by a tender offer. In a tender offer a firm offers to buy the outstanding stock of another firm at a specific price publicly. The offer is communicated to the target firm’s shareholders by public announcements such as newspaper advertisements and mailings to stockholders. When the acquirer takes an offer directly to the firm’s management or its board of directors, it is called friendly tender offer. However, if the acquirer approaches the shareholders of the firm directly with a tender offer for their shares, it becomes hostile tender offer. Hostile takeovers are not very popular, for its higher transaction costs.

**Acquisition of Assets**

It is the kind of acquisition that the bidder company purchases the assets of the target company. In the course of the acquisition, the bidder can buy the assets they want and leave the assets and liabilities they don’t want. After that, the assets of the target firm are transferred to the acquiring firm and the target firm remains as an empty shell company. The shareholders of the target firms can get the cash from the acquisition by dividends or through liquidation. The legal process of transferring assets can be costly.

### 2.3 Specific characteristics of the M&A in electricity and gas sector

The new M&A especially the liberalization initiatives in Europe and elsewhere began in the early 1990s because of the reduced political concern over energy supply security. The ending of the cold war made importing gas from Russia less risky in an environment where liberalization favored the building of new gas-fired plants [16].

European reform was pursued at two parallel levels [16]. First, under the EU Electricity Market Directives, member countries were required to take at least a minimum set of steps by certain key dates toward the liberalization of their national markets. Second, the European Commission promoted efforts to improve the interfaces between national markets by improving cross-border trading rules, and to expand cross-border transmission links. Trading rules are being developed with industry agreement and the EU has subsidized some cross-border transmission link upgrades.

The first and second EU Electricity Market Directives of 1996 and 2003 focused on unbundling the industry and on a gradual opening of national markets. The second directive further promotes competition by toughening regulation of access to networks and requiring independent regulators. Regulations of cross-border trade aims to facilitate market integration (Table 1 EU Electricity Directives). The second directive
aims to achieve

(1) unbundling of Transmission System Operators (TSOs) and Distribution System Operators (DSOs) from the rest of the industry;
(2) free entry to generation;
(3) monitoring of supply competition;
(4) full market opening;
(5) promotion of renewable sources;
(6) strengthening the role of the regulator;
(7) a single European market.

In EU countries, raising the standards of regulation came rather late, which was after the market structure and rules had been established. Thus in Italy and Spain, regulators are weak in the face of established incumbent company interests. In mid-2005, despite of the full liberalization of the German electricity market, there was no central energy regulators yet established 1. Also, privatizing state-owned monopolies has not been part of the EU-wide drive toward liberalization of the industry. Therefore the requirements of regulation and other different type of the reforms become imminent. The M&A in the gas and electricity industry has several distinguishing features which will be illustrated in the following paragraphs.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>Monopoly → Authorisation</td>
<td></td>
<td>Authorisation</td>
</tr>
<tr>
<td></td>
<td>Monopoly → Tendering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>Monopoly → Regulated TPA</td>
<td></td>
<td>Regulated TPA</td>
</tr>
<tr>
<td>Distribution</td>
<td>Monopoly → Negotiated TPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monopoly → Single Buyer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply</td>
<td>Monopoly → Accounting</td>
<td></td>
<td>Legal separation from transmission and distribution</td>
</tr>
<tr>
<td></td>
<td>separation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers</td>
<td>No Choice → Choice for</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eligible Customers (−1/3)</td>
<td></td>
<td>All non-household (2004)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All (2007)</td>
</tr>
<tr>
<td>Unbundling T/D</td>
<td>None → Accounts</td>
<td></td>
<td>Legal</td>
</tr>
<tr>
<td>Cross-Border Trade</td>
<td>Monopoly → Negotiated</td>
<td></td>
<td>Regulated</td>
</tr>
<tr>
<td>Regulation</td>
<td>Government → Not specified</td>
<td></td>
<td>Regulatory Authority</td>
</tr>
<tr>
<td></td>
<td>Department</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 EU Electricity Directives

---

1 The regulator for telecommunications and post will also assume responsibility for electricity and gas. The new regulatory authority (REGIP) is pending, for the enactment of the new energy law (ENWG) in 2005.
2.3.1 Restructuring

Restructuring is the corporate management term which refers to the changes of the companies’ structure in order to make the companies more profitable and better organized. One of the popular restructuring methods is separation. An effective separation of transmission system operators from generation is important for effective wholesale competition, because it is beneficial for network competitions. Therefore more and more companies are involved in the vertical separation evolution.

Table 2 Extent of Network Unbundling uses five criteria to show the extent of the separated network from the competitive activities. The table reflects ownership, accounting, regulatory, legal, and physical aspects for effective separation. It also shows that the extent of unbundling of the transmission system has generally higher score than the unbundling of the distribution networks. UK earns the highest score in both aspects of the unbundling operate. Afterwards, Spain and Sweden garner the second highest score, and they make almost the same achievements.

<table>
<thead>
<tr>
<th></th>
<th>Transmission System Operator Score/5</th>
<th>Distribution System Operator Score/5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Belgium</td>
<td>4</td>
<td>3.5</td>
</tr>
<tr>
<td>Denmark</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Finland</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>France</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>4</td>
<td>1.5</td>
</tr>
<tr>
<td>Greece</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ireland</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Italy</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Netherlands</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Portugal</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Spain</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Sweden</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>UK</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>Norway</td>
<td>5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* TSO: Ownership unbundling, Yes=1, No=0; DSO: Legal unbundling, Yes=1, No=0
* Published accounts, Yes=1, No=0
* Compliance officer, Yes=1, No=0
* Separate corporate identity, Yes=1, No=0, Often=0.5
* Separate locations, Yes=1, No=0, Partly=0.5

Brussels region not yet legally unbundled and no compliance officer in Flanders region.

Table 2 Extent of Network Unbundling
2.3.2 Competition

In European countries, many countries already enter in the generation of complete competition, and all large users and small consumers can freely choose their own suppliers [16]. Moreover for the aspect of the distribution utilities, the 2003 Electricity Directive issued that it was not anymore allowed for the single-buyer model to operate the distribution networks. This restriction has already been adopted by Northern Ireland, Portugal and Italy. In addition, the standards of the competition required the third-party access to the distribution networks.

In European electricity market, most of the countries, at least in principle, are now open to competition. Although there is no requirement announced by the directives, some countries have already extended market opening to households. Figure 2 Actual and Expected Levels of Market Opening (by units sold) shows the description of the levels of market opening from 1995 to 2004 in European electricity area. From the chart in the figure we can see there is mounting growth from 1995 to 1999 and the extent gradually enlarged afterwards. The actual market opening exceeded much more than the expected estimation. So based on the results already achieved, the 2003 Directive required that all non-household customers could freely choose their electricity supplier by 1 July 2004, followed by full market opening to all household customers by 1 July 2007.

![Figure 2 Actual and Expected Levels of Market Opening (by units sold)](image-url)
2.3.3 Regulation

Appropriate regulation especially implementing regulated third-party access to distribution networks is rather important for effective competition. Recognizing the importance of this, the 2003 Electricity Directive required member countries to establish independent regulatory agencies. Genoud and Finger [16] observed that a degree of convergence in European electricity regulation with the European Commission is an influential factor to the independent regulatory agencies. Gilardi [19] made a comparative analysis of the independent regulatory agencies in the EU, and concluded the results that electricity industry had varied levels of the agencies and could be more and more independent in the future.

Besides, incentive–based regulation of the distribution networks could make the natural monopoly segment of the industry more efficient and cost saving. Figure 3 Estimated Breakdowns of Expected Electricity Prices in 2004 shows the difference of final price of the electricity paid by the end-users in member countries in 2004. The figure indicates that Germany has the highest transmission and distribution charges due to the absence of incentive-based schemes. However, Norway and UK which are the countries with longest incentive-based regulation of networks have the lowest charges of distribution and transmission. The UK also indicates the lowest retail supply margin.

![Figure 3 Estimated Breakdowns of Expected Electricity Prices in 2004](image)

*Figure 3 Estimated Breakdowns of Expected Electricity Prices in 2004 (50 MWh/year Customer, euro/MWh before Taxes)*
2.3.4 Privatization

EU electricity Directives do not make much effort on the need for private ownership [16]. The most extensive privatization programs have taken place in the UK and Portugal, and Italy has undertaken partial privatization. France although has not yet processed the privatization, it is believed there was possibility in the near future. In the Netherlands the transmission and distribution utilities remained in public ownership until 2005 [20]. The Nordic countries - Norway, Sweden, and Finland - gradually introduced an open international market in electricity during the 1990s. In addition, the EU electricity Directives introduced a new electricity law in 1998 which requires member states to open their electricity markets for international trading. The introducing of the new law was due to such a limitation that member states could require all electricity for public consumption to be sold through a 'single buyer'.

At the early stage of implementing the privatization, by means of splitting large companies to increase competition is easy and effective. In the Netherlands and Norway, this method has another effect that avoids the possibility of national companies falling into the other foreign companies’ hands. As the time goes by, there should be more and more countries getting used to the privatization which breaks down the monopoly situation in the power industry.
Chapter 3 The Opportunities and Barriers of the M&A after the 5th Wave

Prior to the 5th wave, the thinking of the mergers and acquisitions of the electricity and gas industry is mainly about the public reform, and the business among the countries. However, requirements on the private distribution and transmission of the electricity and gas industry could not be neglected any more. More and more European countries begin to realize that these requirements are not dangerous and impossible, but affordable and operational. Alongside, there still exists some difficulties and barriers to the revolution which also needs to pay attention to.

3.1 Opportunities

In the theory of microeconomic it is suggested that competition and the profit motivation result in internal (production) and external (market) efficiency and that the benefits are passed on to customers and the economy in the form of lower prices and costs. The Electricity Supply Industry (ESI) has important physical characteristics that shape its optimal regulatory design. It involves (1) large sunk costs which limit entry possibilities, (2) vertical stages (generation, transmission, distribution and retailing) of production with different optimal scales, and (3) non-storable goods need to be delivered through an instantaneous balance of supply and demand at all nodes. M&A activities bring the competitors more chances to achieve the efficiency, and also the customers more benefits.

M&A especially the form of liberalization in the ESI needs creation of the combination of competitive energy and retail markets. Besides, regulated transmission and distribution activities are important as well. Successful liberalization requires well-organized energy, associated supporting services and transmission capacity markets. These requirements help the competitors to achieve competition much more effective and operational.

Electricity liberalization around the world could produce a measure of consensus over some common measures for achieving a well functioning market-oriented industry. Liberalization generally requires implementation of one or more of the following inter-related steps: sector restructuring, introduction of competition in wholesale generation and retail supply, incentive regulation of transmission and distribution networks, establishing an independent regulator, and privatization [21] [22] described in Table 3 Main Measurements in Electricity Reform.
Table 3 Main Measurements in Electricity Reform outlines the measures for reforming a vertically integrated and publicly owned ESI into a competitive and privately owned industry. In practice, the actual measurement should consider both the specific aspects of the national electricity and gas industry and the general features of the liberalization model.

| Restructuring | - Vertical unbundling of generation, transmission, distribution, and supply activities  
|               | - Horizontal splitting of generation and supply |
| Competition and Markets | - Wholesale market and retail competition  
|                         | - Allowing new entry into generation and supply |
| Regulation | - Establishing an independent regulator  
|            | - Provision of third-party network access  
|            | - Incentive regulation of transmission and distribution networks |
| Ownership | - Allowing new private actors  
|          | - Privatising the existing publicly owned businesses |

*Table 3 Main Measurements in Electricity Reform [21] [22]*

The aim of vertical unbundling is to separate potentially competitive generation and supply from the natural monopoly activities of transmission and distribution networks. The aim of horizontal separation is to create enough effective competition in generation and retailing where economies of scale favor competition. In some situation competition and /or efficiency may be promoted by increased horizontal concentration in retailing or distribution. This may be the case where large numbers of small distribution companies sell electricity (as was the case in the Netherlands until relatively 2005) [23].

Restructuring also includes horizontal splitting of the involved generation firms or merging of retailing firms. These restructuring activities aim to change market concentration to theoretically and empirically competitive levels (usually there should be more than 5 effective competitors in a market). Besides, in order to accelerate competition in generation in the short run and encourage new entry in the long-run, it is essential to prevent high levels of concentration in the existing markets. In the long-run, new entry in generation and supply, and interconnections with other systems can also increase competition in the market. Slow growth and excess capacity in many European electricity and gas markets limit profitable entry opportunities for newcomers, and continuing high levels of concentration in generation and retail markets limit competition [24].
To establish the competitive markets structure requires government initiative. All examples of successful restructuring (England and Wales, Norway) illustrate the essential of the regulation published by the government to facilitate competition. Regulation can be very good at policing a competitive system [25]. Moreover on the regulation measurement, accessing the regulated third-party has proven the most effective and widely used approach to the provision of network access [25].

Regulation also takes into account for the charges of distribution and transmission. Normally the price should be one third of the final electricity or gas prices. In addition, there is significant potential for efficiency improvement and cost savings in European networks both within and between countries, because the average cost inefficiency of the orders is 40% until 2003 in the European electricity and gas industry [26].

Another measurement is about the ownership. Many reforming countries have sold off public enterprises or allowed new private entry. The main effect of privatization is that the pursuit of profit by private owners will lead to efficiency improvement and cost saving [27]. An increase in the ownership diversity can also accelerate direct competition in the generation and supply activities and formulate regulation of networks by comparative performance. In addition, privatization could make some benefits for the government, which could help to reduce the government’s liabilities in the future [28].

In some countries (notably the UK, but also the Netherlands and Spain) the resulting restructuring was accompanied by privatization, in others, such as Germany, private ownership was already common, while yet others retained public ownership (notably France) or partial privatization (Italy). Reasons for this were that privatization put a considerable number of new companies into playing on the stock market. The second reason is that the electricity demand is growing slowly, so organic growth² is slow, leaving profits either to be returned to shareholders or spent on acquisitions. Therefore there is more and more privatization generated within the public owned companies in the industry.

3.2 Problem and barriers

In contrast to the United States, mergers between energy companies in Europe have been subject to rather relaxed standards, and consequently many mergers have been allowed to proceed, which would cause economists considerable disquiet.

In EU, It seems poorly equipped to either assess or prevent problem caused by the mergers. Mergers between mainly domestic energy companies are left to national

---

² Organic growth: in finance, organic growth is the process of business expansion due to increased output, sales, or both.
competition authorities, even when they have significant impacts on other member
states. There is a famous case about the E.On-Ruhrgas merger, which was condemned
by the German Monopoly Commission but approved by the German government.
However, the merger did not fall under the jurisdiction of the European Commission,
although German plays very important role in transmission route in EU and E.On
controls interconnectors into neighbor states.

Although, there is a tendency that the new restructuring will be a trend, several
findings cited that there are still be some problems which restricted the new type of
restructuring. One of the most obvious difficulties of the restructuring of the industry
is the special character which is the industry normally being controlled by the public
and restructured between the countries, and the personal companies not often being
mentioned [17]. Another doubt is whether the personal companies’ joint will make the
efficiency affect the whole industry [17]. Last but not the least, the specific energy
laws in EU and every EU countries are the major barriers to the new reforms.

The other limitation confronting the Commission is the tension between the
longer-run objective of creating integrated and competitive energy markets, and the
short-run test of the impact of a merger. Figure 4 Most Continental electricity wholesale
markets are highly concentrated\(^3\) shows the description of the concentration in EU
electricity industry. From the figure we can see there is an obvious concentration
already formulated in the industry. To break down the concentration and formulate
better competition market seems not easy and crucial.

### 3.3 Research questions and hypothesis

Based on the former analysis, this research will generate two questions about the
situation of the M&A in European electricity and gas industry.

(1) Is the stock value of the observed bidder companies in European electricity and
gas industry significantly affected by the mergers and acquisitions?
(2) What would be the main factors that affect the valuation change of the bidder
companies and what the strength of the influence by these factors are?

To solve the first research question I will set up a hypothesis and use event study to
research (either approves or rejects the hypothesis to give a final conclusion). For the
second research question, I will first set up a model function to formulate the
relationship between the valuation change of the bidder companies and the affecting
factors, and then use regression analysis to quantify the strength of the effects by the
factors.

---

\(^3\) HHI is the Herfindah1 Hirschman Index, the sum of the squared percentage market shares. The measures may
under or overstate market power as they ignore capacity tightness and import options.
Hypothesis 1: There is no impact to the stock value of the bidder companies as a result of the transaction announced in European electricity and gas industry after the 5th wave.

Concentration in EU Electricity, 2004

![Graph showing electricity market concentration in EU countries](image)

Figure 4 Most Continental electricity wholesale markets are highly concentrated

There are numerous of researches on the impact of M&A on target companies, and it is summarized that M&A activities always entail a large gain for the target firm’s shareholders over the market value of the freestanding entity [29]. However, there is very limited number of researches on the influence of the M&A on the bidder companies; therefore I am interested in this topic. I want to know whether there is also positive impact on the bidder side after the announcement date of the restructuring in European electricity and gas industry after the 5th wave.

Research Question 2 is to find out the factors that affect the valuation change of the bidder companies, where the valuation change can be represented as the cumulative abnormal returns around the M&A event time (CAR) from the bidder side. Particularly, there are three factors that I am most interested in, which are:

1. The location of the target (cross border or domestic). Renneboog [3] found that the acquisitions of cross border firm experiences lower premium than the acquisitions of domestic firm. In my research, I will try to find out if different locations have an influence to the valuation change of the bidder companies.
(2) The technique of acquisition (privatization or other forms). New restructuring based on privatization is an important discussion in the study, so I want to research whether the M&A following privatization has an obvious influence on the valuation change of the bidder companies.

(3) The method of payment (pay by cash or other payment methods). Renneboog [3] reported that the bidder’s shareholders favored cash payment more than equity payment because the equity payment pattern declines more than the ones by cash payment. In this research, I will try to find out whether the payment has a significant influence to the valuation change of the bidder companies.

To research the relationship between the three factors and valuation change of the bidder companies, I will first set up a model function to formulate the relationship, and then use regression analysis to quantify the strength of the effect by every factor. For more details refer to chapter 4.
Chapter 4 Data and Methodology

The first research question is whether the mergers and acquisitions affecting the value of the observed companies in European electricity and gas industry. However, it is not easy to measure how much the valuation of a company has been changed after a certain event occurred to the company. One of the common-used methods in corporate finance and investment analysis is to measure the change in the stock price around the time when the event decision becomes public message [1]. Hereafter I refer this approach as the Event Study, which is to use the abnormal stock returns round the event date to carry out some statistical tests. In section 4.2, I will give an introduction in more details to my event study methodology.

The second research question is to find out the main factors that affect the valuation change of the bidder companies. The most interesting factors I want to observe are the location of the target (domestic or abroad), if the acquisition technique is privatization, and if the method of the payment is by cash. The most common method to study the relationship between the independent variables and the dependent variable is regression analysis. I assume it to be a linear regression, and I will use SPSS as the tool to perform the analysis.

4.1 Data collection

To conduct my event study, the data collection is composed of two parts:
(1) Collecting the information (the factors to be observed) of the bidder companies of the mergers and acquisitions;
(2) Collecting the stock price of these companies around the time of mergers and acquisitions announcement.

4.1.1 Collecting the data of the bidder companies

In this thesis I only study the stock price of the bidder companies, because the most studies are about the outcome of the target companies after the mergers and acquisitions, while I want to focus my study on the bidder companies. I make use of the SDC Platinum to collect the companies’ data. SDC Platinum is one of the world’s most comprehensive M&A databases, with US deals dating back to 1979 and other international transactions dating back to 1985. There are many functions of SDC, such as identifying comparable transactions, monitoring markets and industries, prospecting for new business and evaluating advisors. In average there are over 50 deals collected a day. Most data entered into SDC is inputted just one day after the announcement date. For more information on how to use SDC, see the reference [2].
The initial sampling procedure is to collect all the mergers and acquisitions information in electricity and gas sector in European region ranging from 01-Jan-2001 to 31-Oct-2010 (after the 5th takeover wave in Europe according to Renneboog [3]). The data are collected using the industry SIC code for the target and acquirer: 4931 (electric and other service combination), 4911 (electric services), 4932 (gas and other service combination), 4925 (gas production and/or distribution), 4923 (Natural gas transmission and distribution). Attitude could be friendly, hostile or natural. The form of the deals could be acquisition of stock, acquisition of assets, or merger of stock and assets. The deals from the same bidders within less than 200 trading days since previous announcement of a bid are excluded to avoid biases and overlap in estimation the parameters. For more information about these deals, see the thesis attachment 1: mergers and acquisitions deals.

**4.1.2 Collecting the data of the stock price of the bidder companies**

After obtaining the data of the bidder companies, I need to collect the stock price of these companies. The SDC database does not contain the data about the stock price, so another tool needs to be used. I choose Thomson Reuters **Datstream** as the tool. Datstream is one of the world's largest financial statistical databases - covering an unrivalled wealth of asset classes, estimates, fundamentals, indices and economic data. It contains quantitative data for more than 175 countries and 60 markets. Data is provided by a number of organizations including: World scope, International Monetary Fund (IMF), and Organization for Economic Cooperation and Development (OECD) and national government sources which are reliable and trusted [4].

Not every bidder company has the historical stock price stored in the Datastream database. Out of the collected result from step (1), I have found 38 companies with the historical stock price information from the Datastream database. Some of these companies have taken over other companies not just once, so finally there are 51 deals chosen for my data sampling (see Table 4 the bidder companies with the mergers and acquisitions announcement date). For every bidder company, I retrieve the stock price from about 3 years (some company may be less than 3 years due to a shorter history) prior to the mergers and acquisitions announcement date until 30 days after the announcement, using the time series in Datastream (see thesis attachment 2: stock price final part 1 and 2). By now, the data collecting is complete, and the next step is to conduct the event study. In the next section, I will explain how to use these data for the event study.
<table>
<thead>
<tr>
<th>Bidder Company</th>
<th>Announcement Date</th>
<th>Bidder Company</th>
<th>Announcement Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asea Parosleone Industriale</td>
<td>02/28/01</td>
<td>Greentech Energy Systems A S</td>
<td>02/25/02</td>
</tr>
<tr>
<td>ACCERAS</td>
<td>10/10/03</td>
<td>Hjalmark ASA</td>
<td>06/28/01</td>
</tr>
<tr>
<td>ACT N Spa</td>
<td>06/20/02</td>
<td>ENSERGEN</td>
<td>02/21/03</td>
</tr>
<tr>
<td>Air Liquide SA</td>
<td>10/01/04</td>
<td>Ibredo SA</td>
<td>11/28/06</td>
</tr>
<tr>
<td>Areva SA</td>
<td>05/26/03</td>
<td>Imerys Holdings PLC</td>
<td>02/06/01</td>
</tr>
<tr>
<td>AseaPiramide Spa</td>
<td>05/25/02</td>
<td>International Power PLC</td>
<td>05/11/01</td>
</tr>
<tr>
<td>ASW Brescia Spa</td>
<td>09/01/03</td>
<td>05/31/01</td>
<td>11/01/04</td>
</tr>
<tr>
<td>KTEL</td>
<td>09/17/02</td>
<td>08/24/01</td>
<td>10/21/02</td>
</tr>
<tr>
<td>DEK FMB Energie AG</td>
<td>04/06/08</td>
<td>Centrica PLC</td>
<td>08/28/02</td>
</tr>
<tr>
<td></td>
<td>05/31/01</td>
<td>National Grid Group PLC</td>
<td>10/22/02</td>
</tr>
<tr>
<td></td>
<td>04/22/03</td>
<td>OGE</td>
<td>02/09/02</td>
</tr>
<tr>
<td></td>
<td>08/06/05</td>
<td>FEIRRL</td>
<td>10/11/07</td>
</tr>
<tr>
<td>CHF AS</td>
<td>02/28/08</td>
<td>11/11/02</td>
<td></td>
</tr>
<tr>
<td>Drax Group PLC</td>
<td>03/06/09</td>
<td>Red Electrica de Espana SA</td>
<td>11/24/04</td>
</tr>
<tr>
<td>E ON AG</td>
<td>04/09/04</td>
<td>RWE</td>
<td>03/22/02</td>
</tr>
<tr>
<td>EDFIson</td>
<td>09/14/05</td>
<td>Scottish &amp; Southern Energy PLC</td>
<td>10/04/03</td>
</tr>
<tr>
<td>Electrafel SA</td>
<td>01/12/01</td>
<td>Sydkraft AB</td>
<td>01/12/01</td>
</tr>
<tr>
<td>ENDESA</td>
<td>07/12/02</td>
<td>Ternsenergia SA</td>
<td>07/28/10</td>
</tr>
<tr>
<td>EYR AG</td>
<td>07/12/03</td>
<td>TEBESA</td>
<td>01/23/01</td>
</tr>
<tr>
<td>Gas Natural SDG SA</td>
<td>05/17/01</td>
<td>TRANSNET</td>
<td>09/10/07</td>
</tr>
<tr>
<td>Goldman Sachs</td>
<td>07/37/05</td>
<td>Verband AG</td>
<td>05/29/08</td>
</tr>
</tbody>
</table>

Table 4 the bidder companies with the mergers and acquisitions announcement date

4.2 Research methodologies – Event Study

Event study is usually applied to the research of the stock market reaction to the important financial event. Fama, Fisher, Jensen and Roll [5] pioneered the event study methodology to search the behavior of stock prices around stock splits. In their research, they compare the actual returns on the stock around the date of the stock split and the expected return if there had been no event. In my thesis, the purpose of the event study is to find out around the mergers and acquisitions time, if the actual stock return is equal to the normal return. I first set a hypothesis that they are equal, and then I invoke a hypothesis test. According to [1] [6], I split the event study into 3 steps:

1. Identify the event;
2. Calculate the normal stock return;
3. Calculate and analyze the abnormal returns around the event date

4.2.1 Identify the event

The first step to undertake is to define the data upon which the market would receive the news of the event. This is in my paper the date when mergers and acquisitions are announced. In Figure 5 Event Window and Estimation Window, I define the event date as
$t = 0$. However, in many circumstances the news spread gradually to the public, so I am more interested in a certain period around the event date ($t = 0$). This period is called Event Window, and it is defined as $[t_1, t_2]$.

### 4.2.2 Calculate the normal returns

A normal return is referred as the stock return of an individual company if there had been no special event (mergers and acquisitions in my case) occurred on this company. To estimate the normal return of a stock, I need to define an estimation period $[T_1, T_2]$ which proceeds the event period $[t_1, t_2]$. I call this estimation period Estimation Window (see Figure 5 Event Window and Estimation Window). Since the estimation period is before the event period, I can consider the stock return during the estimation period as the normal stock return, but the estimation period should be long enough. The choice of the estimation period is arbitrary. Brown and Warner [7] have used 35 month as the estimation period, while Renneboog [3] used 240 days.

![Figure 5 Event Window and Estimation Window](image)

In my research, I observed 730 days as the estimation period which starts from -940 days to -210 days ($[T_1, T_2] = [-940, -210]$), and the event window lasts for 61 days including 30 days prior to the announcement date and 30 days afterwards ($[t_1, t_2] = [-30, 30]$). Thus the time between the estimation window and the event window ($T_2$ to $t_1$) is 180 days, which is the longer the better, in order to make sure that the event has as little influence to the estimation window as possible.

Each M&A deal should have its own estimation window and event window. However, if the same company has taken over more than one M&A, the event window of one deal may overlap the estimation window of another deal (for instance, BKW FMB Energie took over one company on 04/06/06 and took over another company on 05/31/07). Therefore, if one company has more than one M&A deals happened during a relative short time, I should use the earliest deal to calculate the normal return of this company.

To calculate the normal return of a stock, I use the mean-adjusted return model, which defines the normal return $NR$ as the average return over the estimation period:
where $i$ is the stock index, and $T = T_2 - T_1 + 1$, which equals the number of days during the estimation period.

In the second step of my data collection, what I have obtained from the Datastream database is the historical daily stock price of each bidder company. To calculate the normal return of a stock, I need to first know the daily stock return. Thus to calculate the daily return, I need to use the following formula:

$$ R_{ij} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} $$

where $i$ is the stock index and $t$ refers to time (day). $R_{ij}$ is the stock return for day $t$ and stock $i$; $P_{ij}$ is stock price for day $t$ and stock $i$. The result of the normal return calculation is listed in Table 5 Normal returns of the bidder companies. For more detailed intermediate data, you can also refer to attachment 2-normal return.

<table>
<thead>
<tr>
<th>Bidder Company</th>
<th>Bidder Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Pomeranian Industrials</td>
<td>Goldman Sachs</td>
</tr>
<tr>
<td>NORGAS</td>
<td>Greentech Energy Systems A S</td>
</tr>
<tr>
<td>ACNM Spa</td>
<td>Hafslund ASA</td>
</tr>
<tr>
<td>Air Liquide SA</td>
<td>HARPEN</td>
</tr>
<tr>
<td>Areva SA</td>
<td>Herdrea SA</td>
</tr>
<tr>
<td>Acea SPA</td>
<td>Iconax Holdings PLC</td>
</tr>
<tr>
<td>ASW Brennia Spa</td>
<td>International Power PLC</td>
</tr>
<tr>
<td>BEIL</td>
<td>J &amp; M Stanley</td>
</tr>
<tr>
<td>BPA FMB Energy AG</td>
<td>National Grid Group PLC</td>
</tr>
<tr>
<td>Centrica PLC</td>
<td>NIO</td>
</tr>
<tr>
<td>CEE AS</td>
<td>PETROL</td>
</tr>
<tr>
<td>Pemex Group PLC</td>
<td>Red Electrica de Espana SA</td>
</tr>
<tr>
<td>ENN AG</td>
<td>RWE</td>
</tr>
<tr>
<td>Edison</td>
<td>Scottish A Southern Energy PLC</td>
</tr>
<tr>
<td>ELECTRAI S</td>
<td>Sydsvest ABA</td>
</tr>
<tr>
<td>ENESAI</td>
<td>TernaEnergia Spa</td>
</tr>
<tr>
<td>Etzion</td>
<td>TVEGA</td>
</tr>
<tr>
<td>EVN AG</td>
<td>TRANSHIFTI</td>
</tr>
<tr>
<td>Gas Natural SGC SA</td>
<td>Verbund AG</td>
</tr>
</tbody>
</table>

| Tab. 5 Normal returns of the bidder companies |

4.2.3 Calculate and analyze the abnormal returns

Abnormal return is defined as the difference between the actual return and the normal return, which is illustrated in formula as:

$$ AR_{ij} = R_{ij} - NR_{ij} $$
Where $AR_{i,t}$ is the abnormal return of stock $i$ on day $t$; $R_{i,t}$ is the actual return of stock $i$ on day $t$; $NR_{i,t}$ is the normal return of stock $i$ on day $t$. The calculation result of the abnormal returns is stored in attachment 3 in details.

To analyze the result of the abnormal returns calculation, I construct a matrix of these abnormal returns:

$$
\begin{pmatrix}
AR_{i,t} & \ldots & AR_{N,t} \\
| & \ldots & | \\
AR_{i,t-1} & \ldots & AR_{N,t-1} \\
AR_{i,0} & \ldots & AR_{N,0} \\
AR_{i,1} & \ldots & AR_{N,1} \\
| & \ldots & |
\end{pmatrix}
$$

$AR_{i,t}$ is the abnormal return of stock $i$ on day $t$; $t = 0$ is defined as the event date. Therefore every column of the matrix represents the abnormal returns of one company stock, and every row represents all the abnormal returns of every company on the same day $t$. If there is more than one event happened on one company, then I treat it as separate stocks (different columns). The result of the matrix is stored in attachment 3 in details.

Since I am interested in the performance of an interval, I aggregated the abnormal returns from period $[t_1, t_2]$ as the cumulative abnormal returns ($CAR_i$) of stock $i$.

$$
CAR_i = \sum_{t=t_1}^{t_2} AR_{i,t}
$$

The result of the $CAR_i$ values is displayed in Table 6 Cumulative abnormal returns of the bidder companies. Then I calculate the cumulative average abnormal returns of all the stocks, and it is defined as:

$$
CAAR = \frac{1}{N} \sum_{i=1}^{N} CAR_i
$$

After calculation, the result of $CAAR$ is equal to 0.00725306, and the next step is to perform a statistical test. In this section, the purpose is to test if the M&A events have an influence to the value of the bidder companies. Here I adopt the t-test method as my tool to solve the issue. T-test requires setting up a null hypothesis first; in my case, that is the M&A event has no influence to the valuation of the bidder company, which means that the cumulative average abnormal returns of all the bidder companies should be zero. If translated into math, it is $H_0$ and the alternative hypothesis is $H_1$: 
Table 6: Cumulative Abnormal Returns of the Bidder Companies

<table>
<thead>
<tr>
<th>Company</th>
<th>CAR</th>
<th>Company</th>
<th>CAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accia Firenzese Industrie</td>
<td>0.270398284</td>
<td>Greentech Energy Systems (2001)</td>
<td>-0.114993249</td>
</tr>
<tr>
<td>AGCS</td>
<td>0.209623825</td>
<td>Greentech Energy Systems (2002)</td>
<td>0.493386525</td>
</tr>
<tr>
<td>AGGH Spa</td>
<td>-0.429667977</td>
<td>Greentech Energy Systems (2003)</td>
<td>0.414414329</td>
</tr>
<tr>
<td>Air Liquide SA</td>
<td>0.010696887</td>
<td>HASPEN</td>
<td>-0.18421338</td>
</tr>
<tr>
<td>Areva SA</td>
<td>0.029830455</td>
<td>HASPEN</td>
<td>-0.091455627</td>
</tr>
<tr>
<td>AscoFlare Spa</td>
<td>0.041506194</td>
<td>Iberdrola SA (2002)</td>
<td>0.075775915</td>
</tr>
<tr>
<td>ASM Brescia Spa</td>
<td>-0.05092939</td>
<td>Iberdrola SA (2003)</td>
<td>-0.07585934</td>
</tr>
<tr>
<td>ATEL</td>
<td>-0.051082777</td>
<td>Inergy Holdings PLC</td>
<td>0.019813823</td>
</tr>
<tr>
<td>BBV FMB Energy AG (2006)</td>
<td>0.046652209</td>
<td>International Power PLC (2001)</td>
<td>0.088175205</td>
</tr>
<tr>
<td>BBV FMB Energy AG (2007)</td>
<td>-0.086783509</td>
<td>International Power PLC (2002)</td>
<td>0.238193834</td>
</tr>
<tr>
<td>Centrica PLC (2003)</td>
<td>-0.025478558</td>
<td>NOVAN STANLEY</td>
<td>0.077299562</td>
</tr>
<tr>
<td>Centrica PLC (2002)</td>
<td>-0.268594575</td>
<td>National Grid PLC</td>
<td>0.032900599</td>
</tr>
<tr>
<td>Centrica PLC (2003)</td>
<td>0.213795081</td>
<td>O Alternative (CAAR)</td>
<td>0.113614670</td>
</tr>
<tr>
<td>Centrica PLC (2005)</td>
<td>-0.129814997</td>
<td>PETROL</td>
<td>-0.09580629</td>
</tr>
<tr>
<td>DSA</td>
<td>-0.027184109</td>
<td>Red Electrica de Espana</td>
<td>0.05458036</td>
</tr>
<tr>
<td>Dres Group PLC</td>
<td>-0.029374729</td>
<td>Red Electrica de Espana SA (2002)</td>
<td>-0.037711901</td>
</tr>
<tr>
<td>E.ON (2001)</td>
<td>-0.01062939</td>
<td>Red Electrica de Espana SA (2003)</td>
<td>-0.054027005</td>
</tr>
<tr>
<td>E.ON (2007)</td>
<td>-0.002718122</td>
<td>Scottish &amp; Southern Energy PLC (2001)</td>
<td>-0.059211789</td>
</tr>
<tr>
<td>EDISON</td>
<td>0.002372407</td>
<td>Scottish &amp; Southern Energy PLC (2002)</td>
<td>0.019467733</td>
</tr>
<tr>
<td>ELECTRABEL SA</td>
<td>0.047556753</td>
<td>Scottish &amp; Southern Energy PLC (2003)</td>
<td>0.007967252</td>
</tr>
<tr>
<td>ENDESA</td>
<td>0.058599637</td>
<td>Sykdraft AG</td>
<td>0.461594353</td>
</tr>
<tr>
<td>Enel</td>
<td>0.181077262</td>
<td>TernaEnergia Spa</td>
<td>0.022526965</td>
</tr>
<tr>
<td>ENE AG</td>
<td>-0.112250401</td>
<td>TernaEnergia</td>
<td>-0.03908142</td>
</tr>
<tr>
<td>Gas Natural SDG SA (2007)</td>
<td>-0.08617711</td>
<td>TEAMNEFF</td>
<td>-0.043644928</td>
</tr>
<tr>
<td>Gas Natural SDG SA (2008)</td>
<td>-0.153821449</td>
<td>Telecom Italia</td>
<td>0.165134295</td>
</tr>
<tr>
<td>Goldman Sachs</td>
<td>-0.148532381</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that I have calculated the value of a CAAR, but that is the cumulative average abnormal returns of the sampling bidder companies; while \( \overline{CAAR} \) is the cumulative average abnormal returns of all the bidder companies, which means \( \overline{CAAR} \) covers the complete set of the bidder companies but CAAR not.

The t-test statistical formula is:

\[
t = \frac{\bar{X} - \mu_0}{\frac{s}{\sqrt{n}}},
\]

where \( s \) is the sample standard deviation and \( n \) is the sample size. The degree of freedom used in this test is \( n - 1 \). \( \mu_0 \) is the overall average value (\( \overline{CAAR} \)) and \( \bar{X} \) is the sampling average value (CAAR). \( s \) is calculated as:

\[
s = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (CAR_i - CAAR)^2}
\]
After calculation, the value of $s$ is 0.162044302, and as a result $t$ is equal to 0.319648464. Looking into the t-test value table (double side, statistical significance 0.05), using the degree of the freedom as 50 $(N - 1)$, $t_{0.05} (50) = 2.0090$. Since $|t| < t_{0.05} (50)$, referencing Table 7 $|t|$ value, P value and the statistical conclusion, I can draw the conclusion that:

**Conclusion 1**: $H_0$ cannot be rejected, so I cannot consider that the M&A event has no influence to the value of the bidder companies. In another word, it may influence the value of the bidder companies.

| $\alpha$ (statistical significance) | $|t|$ | P | Conclusion |
|----------------------------------|------|---|------------|
| 0.05                             | $< t_{0.05} (N-1)$ | >0.05 | $H_0$ cannot be rejected; no statistical significance |
| 0.05                             | $\geq t_{0.05} (N-1)$ | $\leq 0.05$ | Reject $H_0$ and accept $H_1$; there is statistical significance |

*Table 7 $|t|$ value, P value and the statistical conclusion*

### 4.3 Research methodologies – Regression Analysis

#### 4.3.1 Observed factors

The second research question is to find out what factors in M&A affect the bidder companies’ valuation change, and how much they affect the valuation change. In my thesis, I will choose three factors to research:

- if the location of the target where M&A took place is cross-border
- if acquisition technique is privatization
- if the payment is by cash

The first factor is about the target location. The issue of the cross-border takeover becomes more and more concerned since the 5th M&A wave occurred. Some researchers believe that the fifth wave is actually the first international wave because of the fast growing cross-border takeover in that period [14]. So I am interested to know whether the M&A target location (cross-border or not) influences the valuation change of a company after the 5th wave.

The second observed element is the acquisition technique of the M&A, especially the privatization. As the privatization is one of the characteristics of the new M&A in electricity and gas industry after the 5th wave, and it becomes a more and more general way of the acquisition techniques after the 5th wave mainly in distribution and transmission networks. Therefore I want to find out what the effect of this feature is to
the valuation change of the bidder companies.

And last but not the least factor is the payment method of the deals. Normally the bidder companies prefer to pay by cash compared to pay by equity, because equity payment pattern declines more than payment by cash [3]. Based on this point I want to research whether the cash payment has a positive effect to the valuation change to the bidder companies.

### 4.3.2 To formulate the relationship between \( CAR \) and the factors

As I have explained in the earlier sections, the valuation change of a company can be represented by the abnormal return, and since I observer a company during an event period, I use the cumulative abnormal return (\( CAR \)) over the event period as the quantitative representative of the valuation change of a company. So to study the relationship between the valuation change of a company and the three factors is to find out what the relationship is between \( CAR \) and the three factors.

The method I will use for this study is regression analysis. Regression analysis is a method, which is based on obtaining massive data, and use statistical method to formulate the relationship between dependent variables and independent variables as a model function. In my research, the dependent variable is the cumulative abnormal return (\( CAR \)), and the independent variables are the three factors that I want to observe. Besides, normal return (\( NR \)) may have an influence to \( CAR \), so although I am not interested in if it really affects \( CAR \) or how it affects \( CAR \), to make the formulation more precise, I will also include \( NR \) as an independent variable.

Depends on the relationship between the dependent variable and the independent variables, the model function can be linear or non-linear. A linear regression analysis is a lot easier than a non-linear regression analysis, and usually if the model function is non-linear, people will try to convert it to a linear function. To simplify the research, I assume that this model function should be linear. For more detailed introduction about regression analysis, you can refer to [31].

Now as I have assumed that the model function should be linear, and the value of \( CAR \) is affected by the three observed factors and the normal return value, I can formulate the model function as:

\[
CAR_i = \alpha + \beta_1 D1_i + \beta_2 D2_i + \beta_3 D3_i + \beta_4 NR_i + \varepsilon
\]

Where:
- \((CAR_i)\) represents the cumulated abnormal return of stock \( i \) over the event period;
- \((\alpha)\) represents a constant term;
• \((D1_i)\) represents the location of the target, where (1) is cross border and (0) is domestic;
• \((\beta_1)\) represents the coefficient of \(D1_i\);
• \((D2_i)\) represents the acquisition technique, where (1) is privatization and (0) is for others;
• \((\beta_2)\) represents the coefficient of \(D2_i\);
• \((D3_i)\) represents the means of payment, where (1) is by cash and (0) is by other methods;
• \((\beta_3)\) represents the coefficient of \(D3_i\);
• \((NR_i)\) represents the normal return.
• \((\beta_4)\) represents the coefficient of \(NR_i\);
• \((\varepsilon)\) represents a noise term reflecting other factors that influence \(CAR_i\).

\(\beta_1, \beta_2, and \beta_3\) represent the strength that the corresponding independent variable affects the dependent variable. My purpose is to use regression analysis to produce an estimate of \(\beta_1, \beta_2, and \beta_3\), and the tool I am going to use to help me do the regression analysis is SPSS.

### 4.3.3 Regression Analysis by SPSS

SPSS is a computer program used for statistical analysis. Between 2009 and 2010 the premier vendor for SPSS was called PASW (Predictive Analytics Soft Ware) Statistics, while copyright issues for the name were settled. The company announced July 28, 2009 that it was being acquired by IBM and as of January 2010, it became "SPSS: An IBM Company" [30].

To start the regression analysis using SPSS, I need to first prepare the input data file, which contains the data of \(CAR, Crossboarder (D1), Privatization (D2), Cash (D3)\) and \(NormalReturn (NR)\). The input data is stored in attachment 4, which is an Excel sheet, but later converted to the format that SPSS recognizes. After the input file is ready, the next step is to start the real regression analysis.

**1) Analyze Crossboarder (D1)**

First I analyze only the relationship between \(CAR\) and \(Crossboarder\), and the syntax I use is:

```plaintext
regression
   /dependent CAR
   /method=enter Crossboarder
```
I use the **regression** command for running this regression. The `/dependent` subcommand indicates the dependent variable, and the variables following `/method=enter` are the predictors (independent variables) in the model. This is followed by the output of these SPSS commands.

### Variables Entered/Removed

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crossboarder(^a)</td>
<td>-</td>
<td>Enter</td>
</tr>
</tbody>
</table>

\(^a\) All requested variables entered.

\(^b\) Dependent Variable: CAR

### Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.011(^a)</td>
<td>.000</td>
<td>-.020</td>
<td>.1636801468747</td>
</tr>
</tbody>
</table>

\(^a\) Predictors: (Constant), Crossboarder

### ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>.000</td>
<td>1</td>
<td>.000</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1.313</td>
<td>49</td>
<td>.027</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.313</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Predictors: (Constant), Crossboarder

\(^b\) Dependent Variable: CAR

### Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td>Beta</td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>.009</td>
<td>.030</td>
<td>.288</td>
</tr>
<tr>
<td></td>
<td>Crossboarder</td>
<td>-.003</td>
<td>.046</td>
<td>-.011</td>
</tr>
</tbody>
</table>

\(^a\) Dependent Variable: CAR

The output is saved in attachment 4. The coefficient of **Crossboarder** is \(b=-0.003\) which indicates that **Crossboarder** has a very minor influence to the value of **CAR**. The significance of **Crossboarder** is \(sig=0.941\), and because it is greater than 0.05, that means the coefficient is not significantly different from zero. As a result, it seems that **Crossboarder** is not related to the value of **CAR**, however, this model is only using a single factor **Crossboarder** as the independent variable, so maybe if I include...
this factor together with the others in the model, the analysis result may be different. I will run the regression analysis with all the observed factors in part (4), and for more detailed explanation about the SPPSS output, you can refer to part (5) in this section.

(2) Analyze Privatization (D2)
To analyze the relationship only between CAR and Privatization, the syntax I use is:

```
regression
  /dependent CAR
  /method=enter Privatization
```

And the output is:

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Privatization a</td>
<td></td>
<td>Enter</td>
</tr>
</tbody>
</table>

a. All requested variables entered.
b. Dependent Variable: CAR

**Model Summary**

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.194a</td>
<td>.037</td>
<td>.018</td>
<td>.1605940023447</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Privatization

**ANOVA**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>.049</td>
<td>1</td>
<td>.049</td>
<td>1.907</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1.264</td>
<td>49</td>
<td>.026</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.313</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Privatization
b. Dependent Variable: CAR
### Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td>t</td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>.021</td>
<td>.024</td>
<td>.843</td>
</tr>
<tr>
<td>Privatization</td>
<td>-.085</td>
<td>.062</td>
<td>-.194</td>
<td>-1.381</td>
</tr>
</tbody>
</table>

a. Dependent Variable: CAR

The coefficient of *Privatization* is $b=-0.085$ which indicates that *Privatization* has a very minor influence to the value of *CAR*. The significance of *Privatization* is $sig=0.174$, and because it is greater than 0.05, that means the coefficient is not significantly different from zero. As a result, it seems that *Privatization* is not related to the value of *CAR*, however, this model is only using a single factor *Privatization* as the independent variable, so maybe if I include this factor together with the others in the model, the analysis result may be different. I will run the regression analysis with all the observed factors in part (4), and for more detailed explanation about the SPSS output, you can refer to part (5) in this section.

(3) **Analyze Cash (D3)**

To analyze the relationship only between *CAR* and *Cash*, the syntax I use is:

```plaintext
regression /dependent CAR /method=enter Cash
```

And the output is:

### Variables Entered/Removed

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cash</td>
<td></td>
<td>Enter</td>
</tr>
</tbody>
</table>

a. All requested variables entered.

b. Dependent Variable: CAR
The coefficient of Cash is $b=0.081$ which indicates that Cash has a very minor influence to the value of CAR. The significance of Cash is $sig=0.110$, and because it is greater than 0.05, that means the coefficient is not significantly different from zero. As a result, it seems that Cash is not related to the value of CAR, however, this model is only using a single factor Cash as the independent variable, so maybe if I include this factor together with the others in the model, the analysis result may be different. I will run the regression analysis with all the observed factors in part (4), and for more detailed explanation about the SPSS output, you can refer to part (5) in this section.

(4) Analyze Crossboarder, Privatization, Cash and NormalReturn
I have analyzed Crossboarder, Privatization, Cash separately, and it seems that they are all unrelated to the value of CAR, however to make my analysis more precise, I try to analyze them all together with normal return again. The syntax is:
Variables Entered/Removed

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NormalReturn, Privatization, Crossboarder, Cash&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Enter</td>
<td></td>
</tr>
</tbody>
</table>

a. All requested variables entered.

b. Dependent Variable: CAR

Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.288&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.083</td>
<td>.003</td>
<td>.1617637695523</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), NormalReturn, Privatization, Crossboarder, Cash

ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>.109</td>
<td>4</td>
<td>.027</td>
<td>1.043</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>1.204</td>
<td>46</td>
<td>.026</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.313</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), NormalReturn, Privatization, Crossboarder, Cash

b. Dependent Variable: CAR
The output is saved in attachment 4. The analysis result seems to be unchanged compared to the previous analysis.

- None of the factors, Crossboarder ($b=-0.024$, $sig=0.620$), Privatization ($b=-0.077$, $sig=0.236$), or Cash ($b=0.076$, $sig=0.158$) is related to the value of CAR;
- In table “ANOVA”, the significance value is 0.395, which indicates the independent variables do not show a significant relationship to the dependent variable;
- In table “Model Summary”, the value of $R^2$ (0.083) and the value of Adjusted $R^2$ (0.003) are so different, which is very possibly caused by that the input data for the regression analysis is not sufficient (I have 51 input data for the regression analysis). To verify that I need to obtain more data and run the analysis again in the future.

In the following section, I will illustrate the output parameters by SPSS and then draw a final conclusion about the second research question.

(5) Explanation of the SPSS output
To explain the output parameters by SPSS, I will take the analysis (4) as the example, which is more meaningful, because that regression analysis includes all the independent variables.

Table “Variables Entered/Removed” is a summary of the analysis, showing that CAR is the dependent variable and Crossboarder, Privatization, Cash and NormalReturn, are the independent variables.

Table “Model Summary”:
- $R$ is the square root of $R^2$ (the next column).
- $R^2$ is the proportion of variance in the dependent variable which can be predicted from the independent variables. In analysis (4), this value indicates
that 8.3% of the variance in CAR can be predicted from the independent variables.

- **Adjusted R square.** In simplicity, the closer this value is to R Square, the better the regression analysis is. When the number of the input data is small, while the number of observed independent variables is large, there will be a great difference between R Square and Adjusted R square (as in my analysis, where R Square is 0.083, while Adjusted R Square is 0.003). By contrast, when the number of the input data is large, and the number of observed independent variables is small, the value of R Square and Adjusted R Square will be very close.

- **Std. Error of the Estimate** is the standard deviation of the error term.

Table “ANOVA”: the Total variance is partitioned into the variance which can be explained by the independent variables (Regression) and the variance which is not explained by the independent variables (Residual).

- **Sum of Squares** are the Sum of Squares associated with the three sources of variance, Total, Regression & Residual. The Sums of Squares for the Regression and Residual add up to the Total Variance, reflecting the fact that the Total Variance is partitioned into Regression and Residual variance.

- **df:** These are the degrees of freedom associated with the sources of variance. The total variance has N-1 degrees of freedom. Again the sum of the Regression df and Residual df is equal to the Total df.

- **Mean Square:** the Mean Squares is calculated as, the Sum of Squares divided by their respective df.

- **F:** The F Value is the Mean Square Regression divided by the Mean Square.

- **Sig.:** this value is the p value associated with the F value. You can use this value to answer the question "Do the independent variables reliably predict the dependent variable?" The p value is compared to the alpha level (typically 0.05) and, if smaller, it can be concluded "Yes, the independent variables reliably predict the dependent variable". If the p value were greater than 0.05, you would say that the independent variable does not show a significant relationship with the dependent variable, or that the independent variable does not reliably predict the dependent variable. The p value in my regression analysis is 0.395, which is far greater than 0.05, and as a result, the observed independent variables do not show a significant relationship to the dependent variable. In another word, the observed factors do not show a significant influence to CAR.

Table “Coefficients”: this table quantifies the estimate of the coefficients and their corresponding statistical significance.

- **B:** this is the estimated value of the coefficient. Using these values, the regression analysis model function can be formulated as:
\[ \text{CAR}_t = 0.010 - 0.024 * D1_t - 0.077 * D2_t + 0.076 * D3_t - 2.083 * NR_t + \epsilon \]

- **Std.Error:** These are the standard errors associated with the coefficients.
- **Standardized Coefficients:** These are the standardized regression coefficients. Since all the independent variables are standardized, you can compare the strength that the independent variables affecting the dependent variable. In my regression analysis result, it shows that the payment method has the greatest influence to \( \text{CAR} \).
- **t & sig:** These columns provide the t value and 2 tailed p value used in testing the null hypothesis that the coefficient/parameter is 0. The p value is compared to your alpha level (typically 0.05), and if smaller, you can reject the null hypothesis and say that the coefficient is significantly different from 0; if p is greater than 0.05, then you cannot reject the null hypothesis, which means that the factor may be unrelated to the dependent variable. As my regression analysis result shows, the p values of all the three observed factors are greater than 0.05, which means they may have no influence to the value of \( \text{CAR} \).

(6) **Conclusion**

The purpose of my regression analysis is to estimate how the following factors affect the valuation change of a company (\( \text{CAR} \)).

- \((D1)\) if the location of the target where M&A took place is cross border
- \((D2)\) if acquisition technique is privatization
- \((D3)\) if the payment is by cash

I did four times regression analysis, and every factor has been estimated twice (once separately and once together will all the other factors). Both two times the coefficients of all the three factors are very little numbers, and all the p values are greater than 0.05 (see Table 8 Coefficient estimation and the statistical significance), which indicates that the coefficients are not significantly different from zero (in another word, the three factors are not related to the valuation change of the company)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Separate analysis</th>
<th>Combined analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( B )</td>
<td>( \text{Sig.} )</td>
</tr>
<tr>
<td>Crossborder</td>
<td>-0.003</td>
<td>0.941</td>
</tr>
<tr>
<td>Privatization</td>
<td>-0.085</td>
<td>0.174</td>
</tr>
<tr>
<td>Cash</td>
<td>0.081</td>
<td>0.11</td>
</tr>
</tbody>
</table>

*Table 8 Coefficient estimation and the statistical significance*

In table “Model Summary”, the value of R Square (0.083) and the value of Adjusted R Square (0.003) are so different, which means that the input data for the regression analysis is not sufficient.
Conclusion 2: all the three factors (if the location of the target where M&A took place is cross border or domestic, if acquisition technique is privatization, and if the payment is by cash) are not related to the valuation change of the bidder company. However, to confirm my conclusion, I need to do the regression analysis further based on more data.
Chapter 5 Summary and Conclusions

5.1 Literature review, opportunities and barriers

I did my research on the mergers and acquisitions of the European electricity and gas industry after the 5th wave. In Chapter 2 Literature review, I introduced the history of M&A, which has gone through six waves, and also the classification of the M&A (the difference among Merger and Consolidation, Acquisition of Stock, and Acquisition of Assets). Moreover I specified the characteristics of the M&A in gas and electricity sector, which are mainly restructuring, competition, regulation and privatization.

In Chapter 3, I illustrated the opportunities and the barriers of the M&A after the 5th wave, which aims to clarify the possibility and the difficulty of the bidder and target companies experienced or will experience. After the fifth wave the requirements on the private distribution and transmission of the electricity and gas industry become more and more, so it is a good opportunity to operate the restructuring. And of course there will be somehow the difficulties alongside with the process like higher entry barrier and too relaxed standards of the M&A in electricity and gas industry in Europe.

Then I raised up my two research questions. And I used event study and regression analysis to study them respectively.

(1) Is the stock value of the observed bidder companies in European electricity and gas industry significantly affected by the mergers and acquisitions?
(2) What would be the main factors that affect the valuation change of the bidder companies and what the strength of the influence by these factors are?

5.2 Event Study

In order to research whether the M&A has an effect on the valuation of the bidder companies after the 5th wave in the European gas and electricity industry, I used SDC and Datastream as the tool / database to collect data and perform an event study to find out the result.

As Fama, Fisher, Jensen and Roll [5] proposed, I compared the stock return around the M&A time (event window) and the normal stock return prior to the M&A event (estimation window \([T_1, T_2]\)) to represent if the value of the company has been changed. The difference between the actual stock return \((R_{it})\) and the normal stock return \((NR_{it})\) is called abnormal return \((AR_{it})\), and the sum of the abnormal return of a stock during the event window is called cumulative abnormal return. If the cumulative abnormal return \((CAR_{it})\) is greater than zero, that means the value of the company has
raised; if less than zero, then that means the value declined.

I used SDC to collect all the M&A information in the European gas and electricity industry after the 5th wave, and used Datastream to collect all the stock price data for the bidder companies being involved.

Then I followed a series of formulas to calculate the $CAR_i$ value of every company.

$$R_{i,j} = \frac{P_{i,j} - P_{i,j-1}}{P_{i,j-1}}$$

$$NR_{i,j} = \frac{1}{T} \sum_{s=T_1}^{T_2} R_{i,j}$$

$$AR_{i,j} = R_{i,j} - NR_{i,j}$$

$$CAR_i = \sum_{i=T_1}^{T_2} AR_{i,j}$$

$$CAAR = \frac{1}{N} \sum_{i=1}^{N} CAR_i$$

After calculating the $CAR_i$ value of every bidder company, I obtained the result of $CAAR$ which is equal to 0.00725306. Then the next step is to perform a t-test to see if the M&A events have an influence to the value of the bidder companies. In my case the null hypothesis is to assume that the M&A event has no influence to the valuation of the bidder company, which means that the cumulative average abnormal returns of all the bidder companies ($\overline{CAAR}$) should be zero. If translated into math, it is $H0$ and the alternative hypothesis is $H1$:

$$H0: \overline{CAAR} = 0$$

$$H1: \overline{CAAR} \neq 0$$

Following the formulas below, where $s$ is the sample standard deviation and $n$ is the sample size. The degree of freedom used in this test is $n - 1$. $\mu_0$ is the overall average value ($\overline{CAAR}$) and $\bar{x}$ is the sampling average value ($CAAR$).
After calculation, the value of \( s \) is 0.162044302, and \( t \) is equal to 0.319648464. Looking into the t-test value table (double side, statistical significance 0.05). I can draw the conclusion that, \( H_0 \) cannot be rejected, which means, M&A event may influence the value of the bidder companies.

### 5.3 Regression Analysis

If the M&A event may influence the valuation of the bidder companies, what factors in the M&A event would actually influence the value of \( CAR \), and that is my second research question. In my thesis, I researched three factors below to see if they have affected \( CAR \).

- if the location of the target where M&A took place is cross-border
- if acquisition technique is privatization
- if the payment is by cash

First of all, I analyze all the three factors separately, and the results show that they are not related to the value of \( CAR \), because the coefficients are all very little numbers, and the significance values show that the coefficients are not significantly different from zero (\( Sig. > 0.05 \)). For convenience, I copy the result data below to see the coefficient of every factor and their corresponding significance.

(1) Cross boarder:

<table>
<thead>
<tr>
<th>Coefficients(^a)</th>
</tr>
</thead>
</table>
| \[ \begin{array}{c|c|c|c|c|}
| Model & \text{Unstandardized Coefficients} & \text{Standardized Coefficients} & t & \text{Sig.} \\
| & B & Std. Error & Beta & \\
| \hline
| 1 & \text{(Constant)} & .009 & .030 & .288 & .775 \\
| Crossboarder & -.003 & .046 & -.011 & -.075 & .941 \\
| \hline
| \end{array} \] |

\( ^a \) Dependent Variable: CAR
(2) Privatization:

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>.021</td>
<td>.024</td>
<td>.843</td>
</tr>
<tr>
<td></td>
<td>Privatization</td>
<td>-.085</td>
<td>.062</td>
<td>-.194</td>
</tr>
</tbody>
</table>

a. Dependent Variable: CAR

(3) Payment by cash:

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>-.015</td>
<td>.026</td>
<td>-.575</td>
</tr>
<tr>
<td></td>
<td>Cash</td>
<td>.081</td>
<td>.050</td>
<td>.226</td>
</tr>
</tbody>
</table>

a. Dependent Variable: CAR

And next I analyzed all the three factors together, the regression analysis model function is

\[ CAR_i = \alpha + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 NR_i + \varepsilon \]

Where \( D_{1i} \) represents the location of the target, where (1) is cross border and (0) is domestic; \( D_{2i} \) represents the acquisition technique, where (1) is privatization and (0) is for others; \( D_{3i} \) represents the means of payment, where (1) is by cash and (0) is by other methods; \( NR_i \) represents the normal return. \( \beta_1, \beta_2, \beta_3 \) and \( \beta_4 \) represent the strength that the corresponding independent variable affects the dependent variable. The result shows that the three factors are still not related to the value of \( CAR \). However, the value of R Square and the value of Adjusted R Square are too different, which means that the regression analysis result is not accurate, and I need to use more data for further analysis. For convenience, the result table is listed below.
5.4 Conclusions

As discussed in chapter 4, the two conclusions I draw are:

**Conclusion 1:** \( H_0 \) cannot be rejected, so I cannot consider that the M&A event has no influence to the value of the bidder companies. In another word, it may influence the value of the bidder companies.

**Conclusion 2:** all the three factors (if the location of the target where M&A took place is cross border, if acquisition technique is privatization, and if the payment is by cash) are not related to the valuation change of the bidder company. However, this conclusion may be not accurate due to limited number of input data. To confirm my conclusion, I need to do the regression analysis further based on more data.
REFERENCE


Union, Review of Progress toward Liberalization & Integration”.


[18] Marc-Kévin Codognet, Jean-Michel Glachant, Céline Hiroux, Matthieu Mollard, François Lévêque, Marie-Anne Plagnet, July 2003, “Mergers and Acquisitions in the European Electricity Sector, Cases and Patterns”, Paris France


