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ANALYSIS OF BOARD NETWORKS IN BELGIUM

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Abstract

Boards of directors are a particularly interesting topic as they are the central feature of a company representing the interests of its shareholders. On a larger scale these boards form networks through shared directorships. The links of these networks are the pathways through which information is shared and resources are being transferred. Unfortunately, little is known about the networks formed by Belgian boards of directors and the effects these networks have on the concerned companies. This research tries to shed a new light on Belgian corporate boards.

The companies listed on Euronext Brussels in 2011 and 2016 are investigated. The method employed to analyse the network of Belgian boards is Social Network Analysis. After replicating the network, attributes of the most central boards are being computed. Additionally, the network is inspected for small world properties. The influence of the well-connectedness of a board on its firm's performance is investigated in the last part using multiple regression analysis.

Networks formed by Belgian boards of directors do demonstrate typical characteristics of small world networks, such as a low network density and a high clustering coefficient. This is confirmed by the Watts-Strogatz statistics. Furthermore, the regression analysis indicates that no significant connection is found between a board's well-connectedness and firm performance. We conclude that director network do not provide economic benefits for the companies.

Keywords: *Board of Directors, Board Centrality, Board networks, Firm Performance, Social Network Analysis*

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1 Introduction

Boards of directors are of high interest for the society at large. They form the vital link between the owners and the management of the firm. Therefore an efficiently working board is crucial to adjust the strategy of a company to the interests of the shareholders.

The board is there to represent the interests of the shareholders, yet they have quite often been criticized to fail in this purpose. Every time scandals occur in the US corporate world –think of Tyco, Enron, or the recent financial crisis- the role of the board and their effectiveness in controlling the management or foreseeing future troubles is questioned (Carter & Lorsch, 2004). These corporate failures are not uncommon in Belgium, with as example the Lernaut & Hauspie or Fortis scandals.

These critics have stimulated the interest of investors in the functioning of boards and the demand to reform their way of working. The corporate governance reforms stressed the importance of having independent directors, and a healthy board size and structure, as mean to avoid conflicts of interest between shareholders and management. These reforms also took the form of regulations imposed by governmental or market authorities. (Levrau & Van den Berghe, Determinants of Effective Boards of Directors, 2009)

Furthermore, corporate boards are in a constant state of mutation. Their size is being reduced and they must adapt to new legislations concerning gender diversity (Ferreira & Kirchmaier, 2013). This ever changing landscape raises the question if the Belgian boards did adapt to these transitions and if their way of interacting with each other was altered in the process.

Indubitably, these corporate boards are not isolated entities, but form a network through their shared directorships. An increasing number of studies investigate whether being well-connected can be beneficial to a company. Some argue that a large number of connections is disadvantageous for the firm performance, due to, among other reasons, directors being overcommitted by the many appointments. Others point out a positive effect due to the directors' ability to secure more valuable resources and information through their ties with other companies, while some do not find a clear association between well-connectedness and firm performance.

Most research concerning these board networks are Anglo-American, and few others analysing boards of countries like France, Germany, or Poland. As studies on Belgian boards and their

connection to one another are rather scarce, their analysis could contribute to fill this knowledge gap (Levrau & Van den Berghe, Determinants of Effective Boards of Directors, 2009). This research is important because, at the moment, little is known about how the boards of different Belgian companies interact with each other, or if the quality of their network influences the functioning of the company.

The aim of this empirical research is to provide a better understanding of the interactions between the boards in Belgium. The network is observed at different time intervals such as to see if changes occurred between the observation periods. The network is visualised and statistical data is computed out of it in order to determine if a relationship exists with determinants of firm performance.

1.1 About the paper

The first part of the paper is composed of a literature analysis concerning boards of directors. In the beginning, the literature study provides general information and aims at introducing the reader to the first concepts of corporate boards. The first chapter of the literature study examines the definition of a board of directors and its relationship to shareholders and management. Subsequently, the six main roles of the board as defined in academic literature are examined, as well as an introduction to the different tasks of the board. The second part provides a highlight of the literature regarding the influence of a board's network to its firm performance, as well as an overview of studies performed in Belgium.

After the literature study, the research questions and the methodology are introduced, followed by the body of the research. In the methodology, the method used to analyse the network of boards are explained, as well as the variables employed in the regression analysis. The method considered is that of social networks. The most important concepts of social network analysis that will be used in this Master's Thesis are introduced to the reader. The research is composed of two parts: Firstly an analysis of the board networks, providing an overview of the mechanics applying on the boards in Belgium along with the statistics describing the connections between the different firms. Secondly, the research comprises a multivariate analysis were the possible links between the network data and firm performance are investigated.

The networks of boards is observed at two different times, 2011 and 2017, to form two population samples on which the experimentation is built upon. Additionally, the analysis of the board networks is decomposed in distinct steps. To begin, a visual representation of the networks is constructed using visualisation tools, after which these are visually inspected and commented. This is followed by the computation of the necessary statistics, followed by a comparison with other academic studies.

Once the results of the research have been analysed, a general conclusion is drawn. This also includes a reflection on the limitations as well as an outlook on further possible research.

The general structure of this Master's Thesis is illustrated by Figure 1.

Figure 1: General Structure of the research

2 Literature Review

2.1 Corporate Boards

The first part of this literature review aims at initiating the reader to the concept of the corporate board. The further parts focus more on the interactions between the different boards and there implications for their companies. The last part introduces the reader to the research that was already done on Belgian boards of directors.

2.1.1 What are Corporate Boards?

The board of directors of a company, also known as corporate board, is the highest entity in the management of a firm. The board is composed of several directors and lead by the chairman. The number of directors is defined by the firm's bylaws. According to the agency theory, the directors are agents for the companies' shareholders. (Kakabadse & Kakabadse, 2008)

The board of directors plays this central role of connecting the shareholders to the management. It has to control and assess the management while assisting it at the same time. Nevertheless, the board has to also please actors outside of this Management-Shareholders-Board Triangle. It has to act in the best interests of internal stakeholders, employees of the firm, and external stakeholders, the society at large. (O'Higgins, 2009)

Where do these boards come from? Unlike one would suspect, the board and its chairman appeared prior to the function of CEO. The board dates all the way back to the 18th Century, where the chairman was the first distinguished executive that had a central role of leading the board. The board was not much more than a few individuals gathered around what served as a table with as main goals to monitor the managers and employees, to win and keep the confidence of the owners of the firm and to determine the strategy of the business. (Kakabadse & Kakabadse, 2008)

When we talk about corporate boards, we mainly focus on publicly owned companies. These companies have as purpose to create and serve customers, as well as to improve shareholder value. This is because privately owned companies tend to be self-managed. In this case, a board of directors has lesser importance, as it is assumed the management will naturally tend to operate

in the shareholders' best interest, as these shareholders are also the managers (Colley, Doyle, Logan, & Stettinus, 2003).

Naturally, the directors are bound to certain rules. These rules are written in the act of incorporation, the different bylaws, and finally in shareholders agreements (Colley, Doyle, Logan, & Stettinus, 2003).

Now that an overall view of the corporate boards, we will focus on the roles these boards have to fulfil. Although the board delegates a lot of decisions to the management (Colley, Doyle, Logan, & Stettinus, 2003), the remaining tasks are of great importance. In the end, these roles will give a clue on the interactions between the boards.

2.1.2 What is the Role of Corporate Boards?

To understand the different roles of a board of directors, it is important to understand the duality of the role of director. His foremost important mission is to represent the shareholders and control the company's doing for them. On the other hand, they must also assist management of the company. Several theories have been developed to encompass the different missions of the board. Two theories preponderate in the study of this composition and in the definition of the role of the board: the *Agency Theory* and the *Stewardship Theory* (Levrau & Van den Berghe, Determinants of Effective Boards of Directors, 2009).

- The ***Agency Theory***: This theory divides the owners, defined as principals, from the management, defined as agents, of the companies. The theory prevails when it comes to the study of corporate governance. It is concerned by the conflicts of interests that occur between the principals and the agents as the ownership is divided from the control of the company and the management may pursue to maximize their self-interest in the disadvantage of shareholders. The theory suggests a board dominated by outsiders and independent directors, to counter any possible conflict of interest that may occur *(Levrau & Van den Berghe, Determinants of Effective Boards of Directors, 2009)*.

- The ***Stewardship Theory***: This theory is somehow the opposite of the Agency Theory. It perceives the management as the stewards of the company's assets. The assumption is that the management has good intentions and wants to do its job right, rather than act out of self-interest. Therefore the board should not control the management, but should

assist them in their tasks, as it is assumed that they want to do their job properly *(Hung, 1998)*. This theory suggests a board dominated by insiders that know the company's working well, rather than emphasizing the possible conflicts of interest *(Levrau & Van den Berghe, Determinants of Effective Boards of Directors, 2009)*.

The two aforementioned theories are the most important to define a board's role, but several other theories were developed to define and explain the large number of additional duties directors may have to fulfil. There is no clear consensus among the different specialists about the role of a corporate board. Hung (1998) summarizes really well these different roles. In this paper six major roles of corporate boards are explained supported by six important theories dealing with the corporate world.

Let us take a closer look at the six different roles discussed by Hung (1998):

- The ***Control Role***: Probably the most important role, as it connects the different actors at the top of the firm and makes sure no conflicts are occurring. This role is based on the Agency Theory introduced previously. Remember that the theory deals with soothing the conflicts that can occur between the principal and the agent using different mechanisms. One of these mechanisms is the board of directors, which controls the agent's behaviour. Hung (1998) notes that, according to Tricker, often a too large emphasis is put on this particular role, while the other roles are ignored.This can be linked to the fiduciary duty of Colley et al. (2003).

- The ***Strategic Role***: This role is based on the Stewardship Theory. This role suggests the importance of the board in influencing the many strategic decisions of the management. There again, the importance of this role is somehow criticized by Tricker, according to Hung (1998). He insinuates what can be perceived as some sort of naivety concerning this role, as it does not take the conflicts and power plays that can occur between the different actors into account *(Hung, 1998)*. This role is linked to the duty of supervision of Colley et al. (2003).

- The ***Linking Role***: This role is based on the Resource Dependency Theory *(Pfeffer & Salancik, 1978)*. The theory assumes that different corporations must not be seen as separate entities, but rather in some sort of interlock between themselves. These interlocks are the social networks that exist between the actors (mostly the members of the boards) of the different firms. Through these links valuable resources, on which the different corporations depend, can be allocated. This means that the corporate boards help the corporations to connect to the external environment. The board lets information flow to the corporation and helps it deal with external threats *(Hung, 1998)*.

  This Linking Role is of particular interest for this Master's Thesis, more so than the others introduced in this chapter. The interlocks between the different corporations ultimately form a network of board of directors, with the appointments between the different boards being the interlocks. The Resource Dependency Theory provides a possible understanding on the impact that location of the board in a broader network can have on the firm's performance. As a firm is better connected, it should be able to secure more valuable resources and information needed for its activities. Logically, a well-connected company should therefore perform better than its less-connected peers.

- The ***Coordinating Role***: This role is based on the Stakeholder Theory. In this theory, the objectives of the corporation must be in harmony with the interests of all groups that have to deal with the consequences (positive or negative) of the firm's actions. These people are not only the stockholders and the employees, but also customers, suppliers, or even the government, environmentalists and the whole society. In this role it is the task of the board to coordinate these different interests and translate them to the management. *(Hung, 1998)*

- The ***Maintenance Role***: This role is based on the Institutional Theory. The theory assumes that outside pressure put a constraint on the action possibilities of the board. This pressure is sometimes presumed so high that the board cannot undertake much other action than those preserving the status quo. These restrictions are in the form of social rules and taken-for-granted conventions. This maintenance role means they have

to take into account those social conventions when undertaking actions. This theory is often criticized as over-socialized. *(Hung, 1998)*

- The ***Support Role***: This role is based on the Managerial Hegemony Theory. This theory insists on the fact that modern corporations are run by professional manager that dominate the decision making process. In this process the board is often no more than a "rubber stamp" that acknowledges the decision, but does not take an active part in the process, hence the support role. This results in a board with not much power and that only exists because of legal requirements. *(Hung, 1998)*

  Two reasons are reasons are raised by the author. Firstly, the board is usually appointed by the managers themselves. As they thrive for an extension of this appointment, they will follow the management in their decisions. Secondly, they have to rely on the management's information to do their job and regularly lack information to it properly. (Hung, 1998)

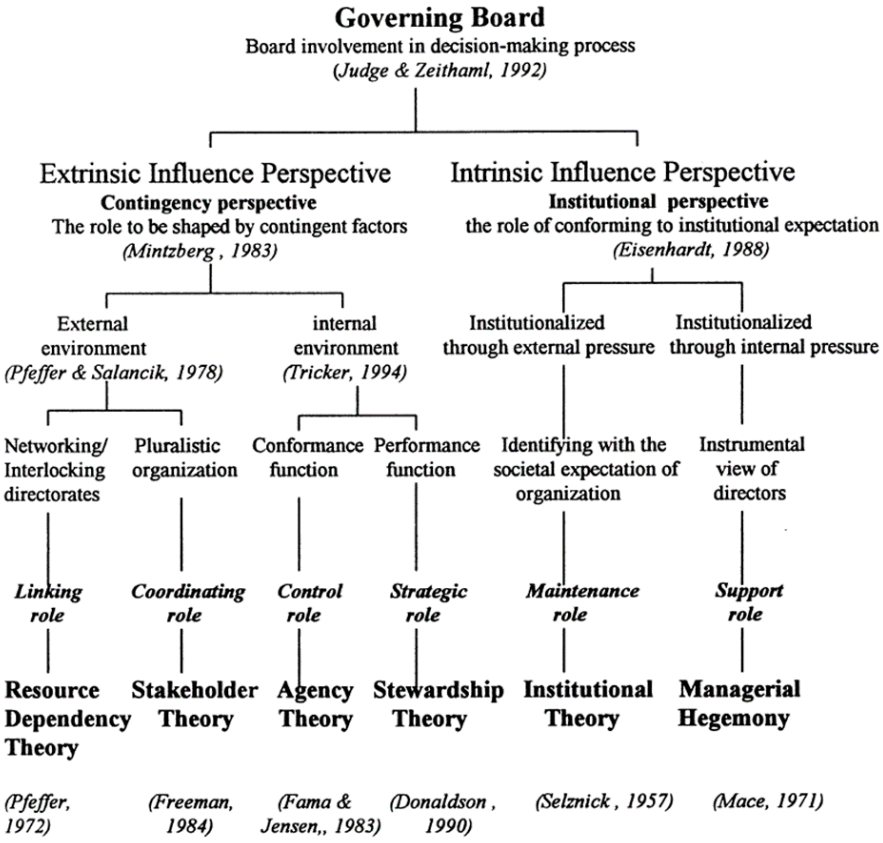

Figure 2: Roles of the Board (Hung, 1998)

Lorsch (2012) adds a few tasks to Hung's theory:

- Manage the CEO's succession: Recently, it has become common to assume that selecting the Chief Executive Officer of a company and managing her or his succession has become the corporate board's prerogative. The job of selecting and developing candidates, the so called crown prince, is still the CEO's responsibility, but these candidates have to be formally approved by the board in case of succession.

- Deciding the amount and the type of compensation to grant to the Chief Executive Officers

It can be concluded that these different typologies of the board, although being often contradictory, must be used complementarily to each other. A board cannot totally focus on one role and neglect another.

The linking role and its resource dependency theory will be investigated further, as they provide a theoretical foundation to the importance of the connections between boards.

2.1.3 Structure of Corporate Boards

Before tackling the importance of the board network, the

A number of determinants of the board structure are investigated in the literature. These are (Colley, Doyle, Logan, & Stettinus, 2003):

- The number of board members
- The number of dependent directors inside the board
- The gender of the board members
- The skills of the board members

The size of the board is also of significance, and can vary along with the type and size of the corporation. Carter & Lorsch (2002) suggest to keep the board size relatively small, to make the working between the board members easier. . Historically, the size had to remain relatively small, as the directors often live in completely different areas, and the scheduling of meetings can become a nightmare. This is less relevant today, where video conferences are widespread and help connecting directors all around the world. (Carter & Lorsch, 2004) On the other hand, Levrau & Van den Berghe (2009) suggest to keep the board's size as large as possible, as the number of directors serves as indicator of the CEO's domination on the board. The larger the board, the more difficult it becomes for the CEO to dominate it, and the easier it gets for the board to monitor the management. (Levrau & Van den Berghe, Determinants of Effective Boards of Directors, 2009)

Colley et al. (2002) investigate the size of American boards in 2000. They find a usual board size between 9 and 16 members. Only few companies tend to have fewer than 10 or more than 18 board members. In Table 4, Sankowska & Siudak (2016) benchmark the average board size among countries. Their averages are smaller than the results from Colley et al. (2002), as they come up with averages ranging from approximately 6 to approximately 13.

Additionally, a specific range of skills is required among the directors and was required in U.S. by the Sarbanes-Oxley Act. For example, they must at least have one expert in financial and accounting matters among them. This is to help the managers in the best possible way (Carter & Lorsch, 2004)

Whether or not the members of the directorship can be part of the management of their firm has been a hot topic due to numerous scandals like Enron or WorldCom. This was not always the case. The most important regulation in the US came with the Sarbanes Oxley Act of 2002 which stipulates that the three principal committees (audit, compensation and nomination) should have independent members only. (Carter & Lorsch, 2004)

The difference between before and after the Sarbanes Oxley Act is clearly recognisable in academic literature. Hung (1998) analyses the different key roles of corporate directors in his 1998 paper, but no mention is made of the independence of these directors.

A shift in mentality is observed after the Act. The book *Back to the Drawing Board* by Carter & Lorsch (2004) is published in 2004 as mean to totally rethink the corporate board, as some

mistakes have been made in the past. Independence of directors play a huge role in their new philosophy, as a complete chapter is dedicated to the subject. Their best practices to achieve this independence are, among others, to elect an independent leader to the board and make sure the directors meet alone from time to time, without the management interfering in the process. (Carter & Lorsch, 2004)

Not only the independence of the board is still a hot topic in more recent research, but also the social ties between directors and the management raise questions. Hoitash (2011) investigates the implications of these social ties in 2011. He concludes that managers with social ties to the directors receive a higher compensation, meaning ethical responsibilities are being violated. Nevertheless, not only negative effects are observed, as internal controls and financial reports tend to have a higher quality due to these social ties. (Hoitash, 2011)

It must be noted that most of these studies come from the US. Carpenter & Westphal (2001) reminds us that there are markedly more restrictions on the type of board connections in the United States compared to Europe, meaning that these possible conflicts of interests have an even bigger importance in Europe. (Carpenter & Westphal, 2001)

2.1.4 Influence of the board on firm performance

A significant amount of academic research that links the well-connectedness of boards to firm performance can be found. Most of the papers analyse American boards (Carter, Simkins, & Simpson, 2002; Larcker, So, & Wang, 2013; Andres, van den Bongard, & Lehmann, 2013), but some also analyse European examples such as Germany (Andres, van den Bongard, & Lehmann, 2013) or France (Kramarz & Thesmar, 2013).

The analysis method used to perform the investigation of the ties between networks is generally Social Network Analysis. Battiston & Catanzaro (2004) suggest that Social Network Analysis is indeed well suited for the investigation of corporate boards. They argue it is well known for boards in the US and elsewhere to have directors serving on several boards at the same time. The details of social network analysis will be documented in the methodology.

When it comes to the influence of board well-connectedness on firm performance, two visions are opposed in the academic literature:

The first group advocates that the well-connectedness has a positive effect on the firm performance. Their arguments are:

- As they have more access to information, well-connected boards will have a comparative advantage for strategic decisions. (Mol, 2001; Larcker, So, & Wang, 2013)
- Well-connected boards tend to reduce asymmetric information when designing contracts. (Larcker, So, & Wang, 2013)
- Well-connected networks can make use of their network to obtain personal or political favours (Mol, 2001; Larcker, So, & Wang, 2013).
- Value creating innovations can spread through the network (Haunschild & Beckman, 1998; Larcker, So, & Wang, 2013)

These arguments seem to corroborate the Resource Dependency Theory. On the other hand, others tend to argue that the disadvantages of a well-connected board outweigh the advantages. Their reasoning is as follows:

- The well-connected directors will be too overcommitted to perform their monitoring duty, therefore well-connectedness would be associated with poor corporate governance. (Fich & Shivdasani, 2006; Andres, van den Bongard, & Lehmann, 2013)

Before making any decision, an overview of performed researches in the field are examined:

Schonlau & Singh (2009) compare the characteristics of board networks to the merger performance of the respective company. Their study shows that boards with a higher centrality, which have therefore a better access to merger relevant information, increase the odds of the firm of achieving a successful acquisition. Additionally, the firm is observed to have higher post-merger financial performance, compared to firms with lower centrality. They also have a higher chance of being acquired by another firm. (Schonlau & Singh, 2009)

On the contrary, Carpenter & Westphal (2001) examine the downsides of the number of director appointments in boardrooms. They base their view on the Agency Theory, which states that the directors have a role of prime importance when it comes to monitor the management, replace underperforming managers and help them develop the right strategy for the company. The researchers conclude that the number of board appointment have indeed a negative influence on

the directors' advising and monitoring roles if their affiliation is to strategically irrelevant firms. (Carpenter & Westphal, 2001)

The author explains that a large amount of studies had been performed on the subject of interlocking corporate boards previous to the 1970s, but none had made use of the techniques of social network analysis. A great shift occurred after the release of Levine's paper in 1972, followed by papers by Mokkern, Helmers and Bearden in 1975. (Scott, 1991)

Andres, van den Bongard, & Lehmann (2013) are of the same opinion as Carpenter & Westphal (2001) concerning the nocuous influence of an overabundance of directorships for a single director. Their argument is that of the busy director, meaning that a plethora of board appointments results in directors that are too busy to perform their monitoring duties efficiently. The methodology used in their research is similar to the one aimed in this Master's Thesis. They compute several network measures among which *Degree Centrality* and *Eigenvector Centrality* on German directorships between 2003 and 2006, and perform fixed-effect regressions with *Tobin's Q* as the independent variable. They find an association between central directors and underperformance of firms. They conclude that this underperformance could be a sign of overcommitted directors.

Previous studies showed a significant advantage for companies having directors with a good network. They managed to match these characteristics with better merger performance. Is it therefore always an advantage to have as many connections as possible? Andres, van den Bongard, & Lehmann (2013) counter argue mentioning a disadvantage: the more connections, the greater the busyness of the directors.

Andres, van den Bongard, & Lehmann (2013) investigates repercussions of the number of social ties of the board to the firm governance. The impulse of the research comes from the fact that many criticize companies for appointing directors that already have directorships in other companies. They argue this busyness impairs the directors' effectiveness in their monitoring duty.

The study examines a total of 133 German firms from which a network is constructed with approximately 1600 directors and 35000 connections. They conclude that boards with a high degree of connectedness tend to have a lower performance (as measured by Tobin's Q) and

higher executive compensation. They consider this an evidence of poor monitoring in companies with busy directors.

From all these diverging views, it is clear that it will not be easy to form a hypothesis on this matter. We tend to believe in the importance of the *Resource Dependency Theory* (Pfeffer & Salancik, 1978) over the overcommitment of boards in this dilemma, and will take it into account when forming the hypothesis in the next chapter.

2.1.5 Belgian Boards

Finally, the literature review is finished by an overview of the research performed on Belgian boards specifically.

As explained previously, studies on the networks of Belgian boards are rather scarce. Mostly, other characteristics of boards are being investigated. Two specialists in the working of and research on Belgian corporate boards are Professor Lutgart Van den Berghe and Professor Abigail Levrau (Van den Berghe & Levrau, 2013a; Van den Berghe & Levrau, 2013b; Van den Berghe & Levrau, 2013c; Van den Berghe & Levrau, 2013d; Van den Berghe & Levrau, 2009). For example, an analysis of the determinants of the effectiveness of Belgian boards of directors was performed by Levrau & Van den Berghe (2009).

Other publications on the more specific topic of board networks in Belgium concern Master's Theses by student.

Examples of this are Moeykens (2011) that does a study on women in the corporate boards in Belgium, or Declercq (2013) that does a study on the connections that exist between the boards of sheltered workshops in Belgium He concludes that interlocks between members of different boards are almost inexistent.

A last notable example that investigates the possible ties existing between Belgian corporate boards are the yearly articles published in the Belgian newspaper 'De Tijd' (Lambrechts, Sephiha, & Roelens, 2016). The last article published in 2016 is rather informative, but does not investigate the properties of the network itself. The authors are focussing on two main subjects: the number of female directors inside the board, to reveal the feminization of the Belgian boards, and which are the most powerful directors of the country. 126 listed Belgian companies are investigated in the article.

It appears that the glass ceiling is starting to fade away. While only 10% of Belgian directors were female in 2010, this amount more than doubled six years later to 23%. The newspaper explains this shift is due to an adjustment of the regulation in 2011. The new law stipulates that boards of directors should be composed of a minimum of one third of women by January 1st 2017. 21 firms do not abide this new law at all, as their board is exclusively composed of men. Most notable examples of these companies are Resilux, Picanol, and Tigenix. Only 27 firms reached the threshold of 33% in 2016. (Lambrechts, Sephiha, & Roelens, 2016)

To compute the 'power' of each director, they take into account the function of the person inside the board, should it be chairman, vice-chairman, CEO or director, and size of the company. The methodology is not revealed, so little is known about the weight each variable has in the final decision of power, nor do they seem to take the importance of the company inside the network into consideration. The most powerful director of 2016 is Luc Bertrand as stated in the article. This is not surprising at all as he is a member of 5 boards of directors, all subsidiaries of Ackermans & van Haaren, of which he is the chairman. Bert De Graeve and Phillippe Vlerick complete De Tijd's top 3 most powerful directors. (Lambrechts, Sephiha, & Roelens, 2016)

Andres, van den Bongard, & Lehmann (2013) suggest that simply using variables as the number of directorships may be too simplistic as a measure to derive the importance of the different individuals inside the network. Golbeck (2013) is of the same opinion, as she urges to not rely on intuition when determining the significance of nodes within a network. On the contrary, she advises to answer these questions quantitatively, with real statistics such as centrality measures. This research aims to answer these questions for the network of Belgian boards. That is when network analysis comes into play. The characteristics of network analysis and how it can help evaluate the Belgian network of boards will be discussed in the next paragraphs.

3 Research goals, questions and hypotheses

The goal of the research is to provide an overview of Belgium's corporate boards' characteristics together with the relationships between the different boards. The observed companies forming a significant part of the Belgian economic tissue, the aim of the Master's Thesis is to grant the reader a better understanding of the board level of these companies and the interlocks between them.

Finally, this Master's Thesis' intention is to contribute to the analysis of boards in a non-Anglo-American context. Most studies are being performed on US and British companies, while studies of the Belgian context are being rather scarce. This empirical research is important in the fact that it is not yet known clearly if a company's board connections influence its performance.

The research questions

Generally, only one research question is advised to state the purpose of a scientific study, but I feel that the topic of this Master's Thesis is too substantial to be encompassed by only one question. Therefore, this empirical research is introduced by the following two questions to incorporate the full scope of the topic:

- *How are the Belgian boards of directors interlocked with one another?*
- *Is the performance of Belgian companies influenced by board Centrality?*

The first question aims at investigating the network of boards and mapping its characteristics, while the second question intends to relate these characteristics to a possible influence on firm performance.

Hypotheses

To formulate a hypothesis for the first question is complicated, as apart from the yearly investigation made by De Tijd, no research on the analysis of board networks in Belgium

specifically is known. Nevertheless, knowing the general structure of the most prominent Belgian companies, which are generally smaller than companies in countries analysed by the literature, such as the U.S. or Germany, I expect lesser ties between them, and thus a smaller network density. I also expect the different directors of the network having typical characteristics for social networks, i.e. few directors having a large amount of direct connections, while the overall majority of directors having only a few connections.

The second hypothesis is as arduous to formulate as the first one. As Larcker, So, & Wang (2013) state: "*ex ante*, there are no clear predictions on the relation between a firm's performance and its board well-connectedness", meaning it is rather difficult to come up with a hypothesis *ex ante*. Three outcomes are possible: the well- connectedness of a board has either a significant positive effect, a significant negative effect, or not a significant effect on its firm performance. From the first hypothesis a low network of ties is predicted with fewer connections than in other countries. Therefore I expect the directors, except some outliers; to not be overcommitted. Subsequently, the busyness and its negative effect on firm performance should not be significant. On the contrary, relying on the Resource Dependency Theory, a positive effect should be seen as well-connected directors will gather information and reduce asymmetric information, influencing the firm performance.

These hypotheses are summarized as follows:

- The network of Belgian boards of directors has a low density.
- Board centrality has a significant positive effect on firm performance.

The second hypothesis is further deconstructed into an empirical specification and regression hypotheses in section.

4 Methodology

The methodology is divided into two sections. The first section provides a step-by-step of the different processes and works performed for the redaction of this research. The second section introduces the reader to the different techniques and variables used in the following chapters.

4.1 Research Process

The goal of the thesis is to perform an analysis of the different boards in Belgium. The following steps will be followed:

1. The data of the different companies must be collected. This will be done on data of two different time periods 5 years apart from each other: 2011 and 2016. This time spacing is ideal to observe the possible changes due to the change in legislation.

2. The descriptive statistics have to be computed out of this data.

3. A program must be written to convert the data of the companies and board members into usable data for the social network analysis programs. This can easily be using Java as programming language and Netbeans 8 as compiling program.

4. The right social network analysis programs must be selected for the purpose.

5. Now that the data has been converted correctly and the right computer program has been selected, the networks can be visualised. Two different configurations are analysed: the network of boards and the network of directors.

6. From the network, statistical data are computed. These are mainly centrality measures such as Degree -, Closeness -, Betweenness - and Eigenvector Centrality.

7. The networks data is analysed to investigate small worlds properties.

8. A multivariate analysis is performed on the obtained statistics. The goal is to obtain insights on a possible influence of network characteristics on firm performance.

9. Conclusions are drawn from the obtained results and analyses.

4.2 Variables and Analysis Techniques

4.2.1 Social Network Analysis Techniques

4.2.1.1 Introduction to the concepts of social network analysis

Social network analysis helps one understand which the important persons inside a particular network are, what subgroups exist inside the network, how information and rumours will spread through the network, and many more. It gives a scientific, statistical measure to the properties of a network and its players. (Golbeck, 2013)

The methods used in the analysis of networks already exist for a long time, but are a hot topic again as online networks are living a golden age. Social network analysis is crucial to understand consumer behaviour and to deal with all aspects of the network. The analysis of larger social networks also became much easier with the development of new analytical software and the rise of higher computational power. (Golbeck, 2013)

Social Network Analysis is particularly useful when performing investigations on interlocking directorships. The main difficulty is using it is that social network analysis is a mixture of social science and more rational elements. It lies at the crossroad between sociology and mathematics. (Scott, 1991)

Inside a social network, each person is regarded as a node, and a connection between two people, or between two nodes, is considered an edge. Often, a node is represented by a circle, sometimes accompanied by a label providing further information. An edge is simply represented by a line between two nodes. An edge can be directed or undirected. A directed edge symbolises a relationship going in one direction, for example when doing a social network analysis on scientific authors, when one author cites another, the relationship is considered as directed, as it does not imply that the other author cited the first one. On the contrary, an undirected edge symbolises a two-way relationship (Golbeck, 2013). This will be the notation used in this research, as we assume that two directors knowing each other goes in both directions.

A number of concepts can now be calculated for the different nodes (representing the companies) and the graph as a whole (representing the network of companies). These concepts are explained in Scott (1991), but can also be found in Degenne & Forsé (1994), in Battiston & Catanzaro (2004), or in Golbeck *(2013)*.

Node Properties:

The first things to analyse, before investigating the whole network, are the individual nodes and their interactions with each other. The purpose of this procedure is to uncover the importance of each node inside the network. This is not as easy to determine as it seems, as node importance is hard to define. The choice is made to employ node centrality to define this importance. These are the measures most frequently used in the literature to assess the importance of nodes in social networks (Golbeck, 2013). Four concepts of node centrality exist, each estimating particular characteristics of the nodes:

- The ***Degree Centrality*** (C_D) expresses the number of direct connections adjacent to a node. This is the easiest and most intuitive property to compute. A high *Degree Centrality* means that the node is connected to a high number of adjacent nodes *(Scott, 1991)*, and is defined as:

$$C_D(n_i) = d_i(n_i) = \sum_{j=1}^{g} x_{ji} \quad (1)$$

- A board with a high *Degree Centrality* means that this board has a large number of directors being part of other boards. This is best illustrated by Figure 3: Degree Centrality example. In this figure, node A has a higher Degree Centrality than node B, as it is connected to a higher number of nodes:

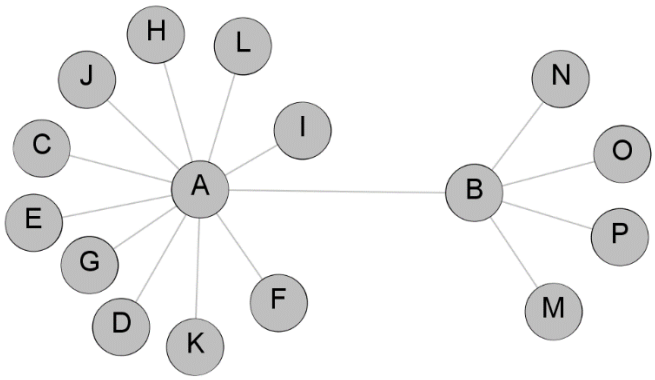

Figure 3: Degree Centrality example

One must be cautious when dealing with degree centrality, as it is rather simplistic. It is not the best property to reveal the importance of a node in a network. Some nodes can have a high degree centrality, but still have a peripheral position in the network. This is illustrated in Figure 4*: Example of a network* , where the node at the centre of the cluster in the upper right corner of the network has a high *Degree Centrality*, but is far away from the core of the network: *(Golbeck, 2013)*

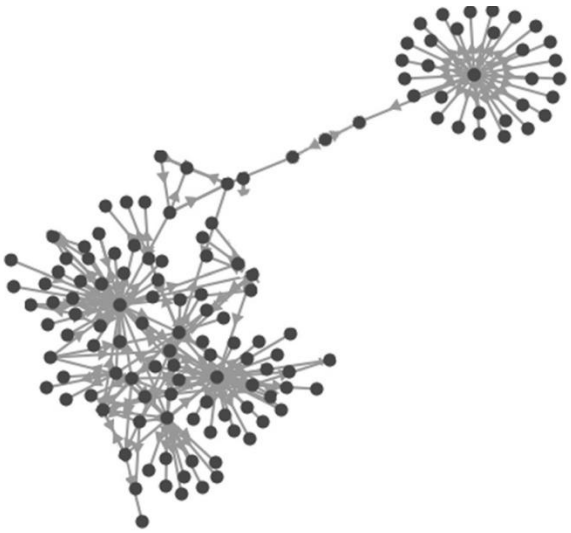

Figure 4: Example of a network (Golbeck, 2013)

- The ***Closeness Centrality*** (C_C) is a proxy that illustrates how close a specific node is to all the other nodes in the network. It is calculated by computing the shortest path from that node to every other node inside the network. Given that l(i,j) is the number of steps in the shortest path between board I and board j *(Larcker, So, & Wang, 2013)*, the *Closeness Centrality* is defined as:

$$C_C = \frac{n-1}{\sum_{j \neq i} l(i,j)} \quad (2)$$

- The ***Betweenness Centrality*** (C_B) expresses the extent in which a particular point is located between other points. For example, a point with a low degree can still have a high importance in the network if it is located between central points. It serves as 'broker' or 'gatekeeper' between these different points. A board of directors with a high *betweenness* could be connected to only a small quantity of boards, but these boards having a large and central position in the network *(Scott, 1991)*. This is best illustrated by Figure 5. In the figure node C has a low Degree Centrality, as it is only connected to two other nodes. Nevertheless, its *Betweenness Centrality* is high, as it is the gatekeeper between node A and node B, funnelling all information between the two nodes. *Betweenness* could therefore be interpreted as the "cost of communicating

with or obtaining favours from another firm" *(Larcker, So, & Wang, 2013)*.

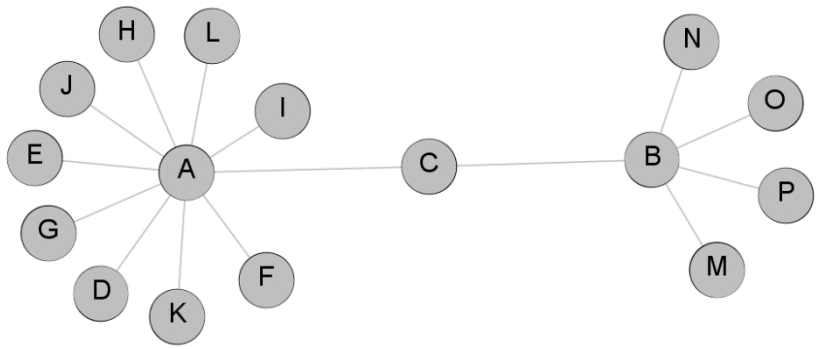

Figure 5: Betweenness Centrality example

Larcker, So, & Wang (2013) define *Betweenness Centrality* as "the average proportion of paths between two outside boards on which a board lies." They define the equation for *Betweenness Centrality* as follows[1]:

$$C_B = \sum_{j \neq i : i \notin (k,j)} \frac{\frac{P_i(k,j)}{P(k,j)}}{\frac{(n-1)(n-2)}{2}} \quad (3)$$

- The ***Eigenvector Centrality*** (C_E) is expressed in terms of number of points to which the point is connected, relatively to the distances among the various points. This concept expresses the importance of the point in the particular network. For example it can express the ease that a central company has to access information, compared to more peripheral companies *(Scott, 1991)*. Notions of prestige and power are captured by this concept *(Larcker, So, & Wang, 2013)*. The attribute is obtained by using matrix calculations on the adjacency matrix to compute the principal eigenvector *(Golbeck, 2013)*:

$$\lambda \, . \, C_{Ei} = \sum_j g_{ij} C_{Ej} \quad (4)$$

[1] $P_i(k,j)$ being the total number of shortest paths between node k and node j going through node i, and P(k,j) being the total number of shortest paths between node k and node j (Larcker, So, & Wang, 2013).

To recapitulate, these four attributes each incorporate distinct importance of a node inside the network. The *Degree Centrality* giving the importance in the immediate surroundings. The *Closeness Centrality* giving the importance in information sharing speed, the closer a node is to the other nodes, the faster information will travel to en from it. The *Betweenness Centrality* providing the importance of the node as information gatekeeper between other nodes. Finally the *Eigenvector Centrality* supplying the importance throughout the whole network.

To compare these attributes between different networks, the centralities should be normalised by dividing the value by the amount of nodes inside the network. The obtained results are percentages that are easily comparable (Andres, van den Bongard, & Lehmann, 2013).When applying these four concepts to perform multivariate analysis, Larcker, So, & Wang (2013) recommend to not use the raw data, but to divide the results in five quintiles. This is mainly due to the high skewness of the different centralities, with few nodes having a high centrality, and the remaining large number of nodes having only a small centrality (Golbeck, 2013). Additionally, Larcker, So, & Wang (2013) recommend bundling these four obtained quintiles into a fifth statistic to provide the overall centrality of the node, incorporating all four concepts. This fifth concept, called the ***N-Score***, is defined as follows:

$$\begin{aligned} N-Score = Quint(\frac{1}{4}\{&Quint(Degree\ Centrality_i) \\ &+ Quint(Closeness\ Centrality_i) \\ &+ Quint(Betweenness\ Centrality_i) \\ &+ Quint(Eigenvector\ Centrality_i)\}) \end{aligned} \tag{5}$$

This *N-Score* provides the "overall well-connectedness of a node" (Larcker, So, & Wang, 2013). Table 1 illustrates which centrality measures are used in the academic literature. We deliberately choose for the measures used by Larcker, So, & Wang (2013) as they encompass the full scope of centralities.

Table 1: Centrality measures employed in the academic literature

	Degree Centrality	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
Sankowska & Siudak (2016)	-	-	-	-
Andres, van den Bongard, & Lehmann (2013)	X	-	-	X
Larcker, So, & Wang (2013)	X	X	X	X
Schonlau & Singh (2009)	X	-	X	X
Kramarz & thesmar (2013)	-	-	-	-

Network Properties and small world properties:

After examining the properties of the different directors, the network as a whole should be investigated. The properties of the network will give insights that enable comparison between different networks. In this particular research the network's properties provide a possibility to compare the Belgian network to foreign networks that were already analysed by fellow researchers. These properties provide a broader perspective on the whole network, which would be difficult to acquire by solely observing node properties. The following network properties will be analysed:

- The ***Network Density*** (ϱ): Ratio between the maximal possible number of edges in the network and the actual number of edges. In terms of boards of directors a high density means that the boards are well-connected with a large number of directors being part of several different boards. On the other hand, a low density means that most directors are part of only one board and that these are not well connected *(Scott, 1991).* The network property is defined as follows[2] *(Sankowska & Siudak, 2016)*:

$$\rho = \frac{2m}{N(N-1)} \tag{6}$$

- The ***Average Shortest Path Length*** (L): Also known as *mean geodesic distance*, this is the average of the shortest paths between two nodes i and j (Sankowska & Siudak, 2016). A high value means, on average, a large distance between two nodes. This can result in a higher degree of information asymmetry. The property is given by following formula[3]:

[2] N being the number of nodes and m being the number of edges present
[3] with N the number of nodes and d(i,j) the shortest path between nodes i and j

$$L = \frac{\sum_{i \in V} \sum_{i \neq j \in V} d(i,j)}{N(N-1)} \quad (7)$$

- The ***Network Clustering Coefficient*** (C): A high Clustering Coefficient implies a higher tendency for the nodes inside the network to form clusters separated from the other nodes. Watts & Strogatz (1998) define it as the mean of local clustering coefficients[4]:

$$C = \frac{\sum_{i=1}^{N} C_i}{N} \quad with\ C_i = \frac{2m_i}{k_i(k_i - 1)} \quad (8)$$

Resulting from the network properties, the small worlds properties of the networks can be analysed. The *Small Worlds Theory* is derived from the 1960s research by Milgram (1967), coming from the observation that people that are physically separated by long distances from each other are generally connected by relatively short paths. This degree of separation was observed to be generally six steps, also known as the *six degrees of separation.* These small world networks demonstrate the following attributes (Golbeck, 2013) (Battiston & Catanzaro, 2004):

- They have rather small *average shortest paths*, meaning two random nodes are usually not far from each other through shared connections. They maintain this property, even for very large networks (Golbeck, 2013).
- They exhibit a high *clustering coefficient*, with the nodes forming small packs that are interconnected with each other (Golbeck, 2013).
- They exhibit a lower tendency to form edges, resulting in a lower *network density* (Sankowska & Siudak, 2016) (Battiston & Catanzaro, 2004).

These properties can be of particular interest for boards of directors. A network of boards exhibiting this phenomenon would have a higher speed of information transfer compared to randomly generated networks. To find out whether a particular network exhibits these properties, Watts & Strogatz (1998) suggest comparing the network's attributes to those of a

[4] with *m* being the number of connections between adjacent nodes and *k* the degree of the node

randomized network with the same number of nodes and the same average degree. The asymptotic approximations of the *Average Shortest Path Length* (L_{RANDOM}) and *Network Clustering Coefficient* (C_{RANDOM}) of a randomized network are calculated as follows (Sankowska & Siudak, 2016):

$$L_{RANDOM} \sim \frac{\ln(N)}{\ln(\bar{k})} \; and \; C_{RANDOM} \sim \frac{\bar{k}}{N} \tag{9}$$

These attributes of the randomized network are then compared to the attributes of the actual network (Sankowska & Siudak, 2016):

$$\gamma^{WS} = \frac{C_{ACTUAL}}{C_{RANDOM}} \; and \; \lambda^{WS} = \frac{L_{ACTUAL}}{L_{RANDOM}} \tag{10}$$

Finally the ***Watts-Strogatz Statistic*** is computed (Sankowska & Siudak, 2016):

$$S^{WS} = \frac{\gamma^{WS}}{\lambda^{WS}} \tag{11}$$

This statistic indicates the small-world property of a network if $S^{WS} > 1$.

Software Used

Scott (1991) suggests gathering the data into an excel document and perform the calculations by a social network package. UCINET and GRADAP are particularly recommended by the author. On the other hand, Goldbeck (2013) suggests using GEPHI as software to perform the social network analysis. For this Master's Thesis, the choice was made to GEPHI to perform the visualisation of the network and NETMINER to perform the calculations of the network properties, because of their ease of use compared to the older software packages that are UCINET and GRADAP.

4.2.1.2 Social Network analysis in practice

4.2.1.3 Networks of boards and networks of directors

After the collection of the necessary data, the input for the social network analysis will be computed. In this phase, two distinct networks will be formed. This approach of dissociating the data into two networks has as purpose to analyse it on all its levels. It is important to not mix both dimensions and risking having nodes representing directors and other nodes representing companies in the same network, as the centrality measures will be distorted (Golbeck, 2013).

The first level establishes a representation of the ties that interconnect the companies, without focusing on which directors are responsible for these connections. Each node of this network will be a company. These networks will be mentioned as networks of boards in the future steps of this research.

The second level represents the connections between the different directors, without taking the different companies they are part of. Each node of this network will be a director. These networks will be mentioned as network of directors in the future steps of the research.

The difference between a network of boards and a network of directors is illustrated by Figure 6 and Figure 7. These figures represent a case where two companies, company A and company B, both have 9 directors being part of their respective boards. A connection is formed by director 9, having a directorship on both boards.

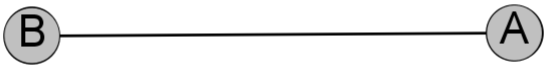

Figure 6: Example of a network of boards

Figure 6 represents the network of boards for this case, with two nodes for each companies and one connection between them with no mention of the directors.

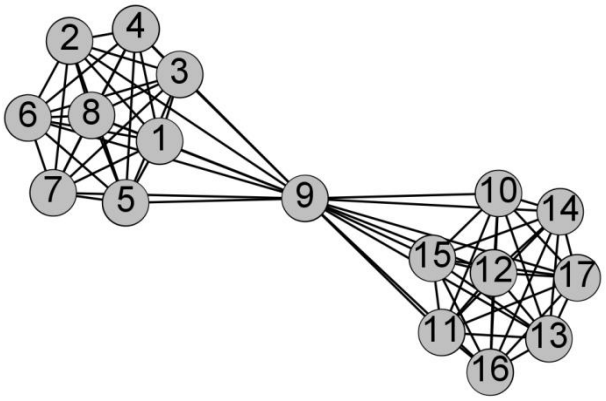

Figure 7: Example of a network of directors

Figure 7 represents the network of directors for this case, with two clusters of nodes representing both companies, and one director connecting both clusters.

Both types of networks are used in the literature to represent the ties between companies. Some make use of both types of networks (Sankowska & Siudak, 2016), whiles others work exclusively with one of the configurations (Andres, van den Bongard, & Lehmann, 2013; Larcker, So, & Wang 2013; Schonlau & Singh, 2009). The choice between the network of boards and the network of directors to construct the centrality measures is explained in Chapter 6.1.3.3. Table 2 illustrates which networks are used in the academic literature.

Table 2: Types of network analysed in the academic literature

	Network of directors	Network of boards
Sankowska & Siudak (2016)	X	X
Andres, van den Bongard, & Lehmann (2013)	X	-
Larcker, So, & Wang (2013)	-	X
Schonlau & Singh (2009)	-	X
Kramarz & thesmar (2013)	-	-

4.2.2 Other Variables

The following list provides a brief description of the additional values used during the regression analysis.

We begin with the two dependent variables that will be regressed independently from each other. These variables are suited indicators of firm performance according to the academic literature.

The two dependent variables are Tobin's Q and the return on assets. The formulas of both variables are as follows:

Tobin's Q is assumed to reflect the agency costs resulting from board busuyness (Ferris, Jagannathan, & Pritchard, 2003). The market-to-book ratio is used as a proxy of Tobin Q (Andres, van den Bongard, & Lehmann, 2013):

$$Tobin's\ Q = \frac{Market\ value\ of\ Equity + Book\ Value\ of\ Liabilities}{Total\ Asset\ Value}$$

The return on assets is used as a proxy of the firm's profitability (Larcker, So, & Wang, 2013):

$$ROA = \frac{Net\ Result}{Total\ Asset\ Value}$$

To conclude, the independent variables are introduced, these variables control for corporate governance and financial characteristics (Andres, van den Bongard, & Lehmann, 2013):

The logarithm of the market value of equity is used as proxy for the size of the company. (Andres, van den Bongard, & Lehmann, 2013)

$$Size = \log(Market\ Value\ of\ Equity)$$

Additionally, the leverage of the company and the logarithm of its asset value are added as independent variables:

$$Leverage = \frac{Total\ Value\ of\ liabilities}{Total\ Value\ of\ Assets}$$

$$Assets = \log(Total\ Asset\ Value)$$

Finally the logarithm of the book to market value is used as last independent variable. (Larcker, So, & Wang, 2013)

$$LBM = \log\left(1 + \frac{Total\ Asset\ Value}{Market\ Value\ of\ Equity + Total\ Value\ of\ Liabilities}\right)$$

5 Dataset

5.1 Sample Selection

Due to the more subjective influence of social sciences, of which social network analysis are classified among, some assumptions have to be made before starting the analysis. First of all Scott (1991) proposes to fix the boundaries of the network to analyse. On the example of business interlocks, he claims that the cut-off of the top 250 companies is often used, as it is a good boundary between large scale and medium scale businesses. In other examples top 50, top 100 and top 500 are also sometimes used (Scott, 1991).

The decision is made to analyse the companies listed on Euronext Brussels. This sample of a little more than 150 companies is right in the recommended sample size of Scott (1991). Other authors (Andres, van den Bongard, & Lehmann, 2013; Larcker, So, & Wang, 2013) analyse much larger sample sizes, but this is simply not possible in the present case. Adding additional Belgian companies outside of Euronext would result in a lot of smaller companies in the sample for which the information would be almost impossible to gather.

Two population samples over different time periods are analysed for this research. The first sample is composed of 133 companies listed at Euronext Brussels in February 2011. The second sample used in this research comprises all 142 companies that are listed at the Euronext Brussels as of the end of 2016. The data regarding the boards' composition are either gathered from the Amadeus Database from Bureau van Dijk or manually collected from the firms' annual reports.

The primary source of information is the Orbis Europe Database of Bureau van Dijk, were the data concerning the directors and the company is obtained. Some limitations occurred when consulting the database. A substantial limitation was the occasionally outdated or missing data. Some directors were also omitted, as only the name of the company they represent was displayed. When it was not possible to collect all information, the annual report was consulted directly from the company's website.

A summary of the gathered data of the selected companies is given in Table 3. Additional information and data regarding the selected companies can be found in Appendix 2 to 5 at the end of this Master's thesis.

Table 3: Data description

Variable	*Mean*	*Median*	*SD*
Panel A: Data Description for 2011			
Market Value (Mio. €)	3,666.21	252.42	13,493.09
Book Value of Assets (Mio.€)	8,631.20	400.70	32,602.45
Tobin's Q	1.20	1.02	0.76
Leverage	0.49	0.51	0.24
Return on Assets	0.80%	2.92%	20.96%
Panel B: Data Description for 2016			
Market Value (Mio. €)	4,336.79	456.75	18,441.32
Book Value of Assets (Mio.€)	10,233.64	443.84	39,193.88
Tobin's Q	1.65	1.25	1.15
Leverage	0.47	0.47	0.44
Return on Assets	-0.13%	2.94%	22.09%

Notes: This table provides descriptive statistics for 137 and 142 Belgian companies in 2011 and 2016 respectively. Tobin's Q is defined as the sum of the book value of debt and the market value of equity divided by the book value of assets. Leverage is defined as the quotient of the book value of debt and the book value of assets. All values are computed at the end of the end of the accounting year.

6 Research and results

6.1 Characteristics of the boards

The first step of the analysis is determining the characteristics of the different boards that will be analysed. Their data is summarized in Table 5. A large amount of statistics could be computed on each possible characteristic of the boards, but we reduce ours to three important statistics: the overall number of board members, the percentage of females on the boards and the number of overcommitted directors. The list of these board properties can be found in Appendix 4.1 and 4.2. The distribution of this data can also be found in Figure 8 to 13.

The average number of directors being member of the boards appears to be relatively steady over time, being around 9 directors per board. This is similar to the values indicated in Sankowska & Siudak (2016), illustrated in Table 4. The distribution of the number of directors per boards, as illustrated in Figure 8 and Figure 9, seems to be skewed to the right. Most boards are located around the average, but a few boards tend to have a director count much higher than the average.

Table 4 Average board size for different countries (Sankowska & Siudak, 2016)

Country (year)	Average board size
Poland (2008)	7.8
UK (2002)	6.51
Germany (2008)	13.3
Germany (2002)	6.33
Italy (2008)	10.16
Switzerland (2000)	9.5
Netherlands (2001)	8.2
US (2003)	9.97
New Zealand (1993)	6.14
Australia (1991)	8.37
South Africa (2008)	8.56
France (1999)	9.48

Looking at the proportion of female directors on Belgian corporate boards, this value drastically increased over the last 5 years, as observed in Table 5. This proportion increased from an average of approximately 8% to an average of approximately 21%. Additionally, the percentage of boards with no female members decreased from more than 54% in 2011 to a mere 20% in 2016. Nevertheless, a large progress still needs to be made, as only 22% of the boards meet the one

third proportion of females set up by the legislation. This appears to be confirmed by the distributions illustrated in Figure 12 and Figure 13.

The data also indicates that the problematic of overcommitted directors is quasi inexistent in Belgian. Only 2.2% of the Belgian directors had more than 2 shared directorships in 2016. In addition to this, no overcommitted boards are found for both 2011 and 2016. These are boards with more than 50% of overcommitted directors. These statistics are much lower than in Germany (Andres, van den Bongard, & Lehmann, 2013), were more than 46% of companies had overcommitted boards in the period 2003-2006. The distribution of the director busyness, as illustrated in Figure 10 and Figure 11, does not appear to change much over the years.

This has serious implications for the regressions performed in this Master's Thesis, as variables indicating board busyness have no point at being included.

Table 5: Description of the board characteristics

Variable	*Mean*	*Median*	*Minimum*	*Maximum*	*SD*
Panel A: Board characteristics for 2011					
Board size	8.83212	8	3	23	3.62095
Percentage of female directors per board	0.08103	0	0	0.5	0.11293
Percentage of boards with >1/3 females	0.058394				
Percentage of boards with no females	0.547445				
Percentage of busy directors per board	0.09212	0	0	0.46154	0.11823
Percentage of busy boards	0				
Percentage of busy directors	0.0350536				
Panel B: Board Characteristics for 2016					
Board size	9.1479	9	3	21	3.4041
Percentage of female directors per board	0.20939	0.22222	0	0.52381	0.13886
Percentage of boards with >1/3 females	0.225352				
Percentage of boards with no females	0.204225				
Percentage of busy directors per board	0.05931	0	0	0.4	0.08557
Percentage of busy boards	0				
Percentage of busy directors	0.0220459				

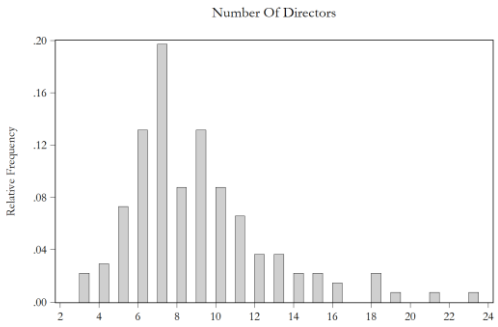

Figure 8: Histogram of the number of directors (2011)

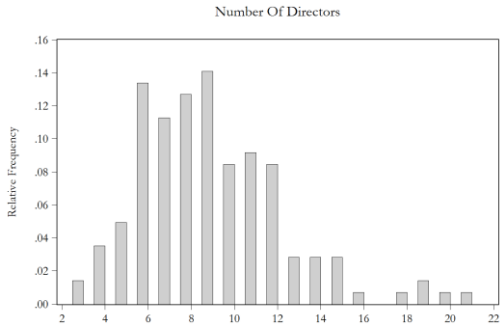

Figure 9: Histogram of the number of directors (2016)

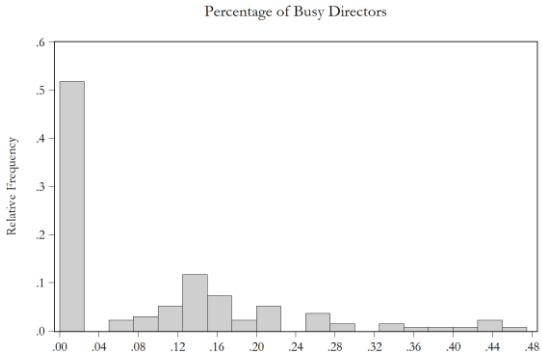

Figure 10: Histogram of the percentage of busy directors (2011)

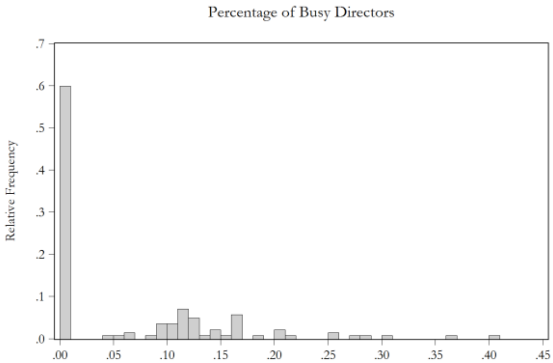

Figure 11: Histogram of the percentage of busy directors (2016)

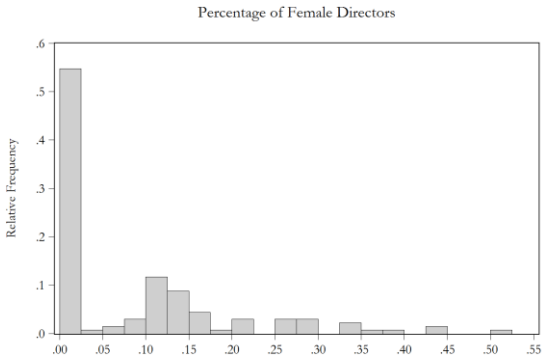

Figure 12: Histogram of the percentage of female directors (2011)

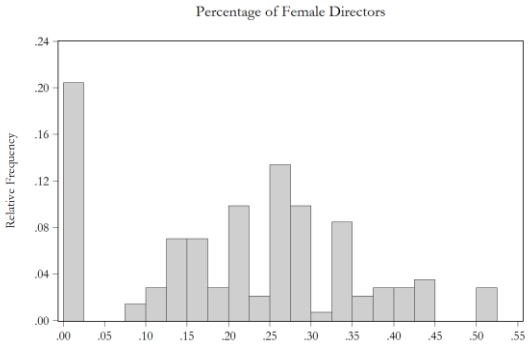

Figure 13: Histogram of the percentage of female directors (2016)

6.2 Social Network Analysis

The second part of the research is composed of the visual replication of the different networks followed by their visual inspection. Subsequently, the measures of board centrality are computed and benchmarked for the most central nodes. Finally, the networks are inspected for small world properties.

As mentioned earlier, both the network of boards and the network of directors will be investigated. The research starts with the network of boards:

6.2.1 Board Networks

6.2.1.1 Visual Inspection

First, the network of boards of 2011 is inspected. The main characteristics of this network are given in Table 6[5].

Table 6: Characteristics of the network of boards (2011)

	Entire Network	*Largest Component*
Number of Firms	137	91
Number of Links	202	196
Average Degree	2.95	4.31
Maximum Degree	12	12
Number of isolated nodes	35	
Number of components	41	
Component ratio	0.29	

Figure 14 depicts the histogram of the Degree Centrality of the network. It is clear from the histogram that a small amount of boards have a large number of external connections, while the overall majority of boards share only few connections.

[5] The number of components is the number of individual clusters not connected with the other clusters. The component ratio is computed as (c-1)/(N-1) and gives the ratio of components

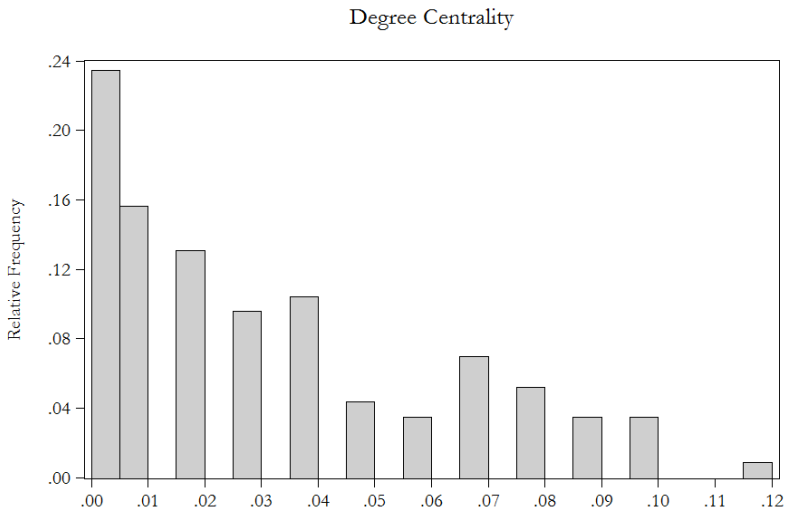

Figure 14: Histogram of the distribution of Degree Centralityof the board network for 2011

The network of boards for 2011 is computed using Gephi. The visualisation of the network is given in Figure 15. The ties between the different boards of directors are represented using the sorting algorithm Force Atlas. Nodes that are coloured in red show a higher Eigenvector Centrality than the nodes coloured in blue.

By visually inspecting the network of the boards of directors, a low network density seems to appear. In the periphery of the graph, a large number of singletons and dyads are represented that do not have any ties to the rest of the network. The general cluster on the left displays a certain number of tails, meaning information will be transmitted only very slowly from one part of the network to the other.

The graph tends to confirm what was concluded from the histogram of the degree centrality. There is a group of node in the centre of the graph with a large number of shared connections, while pthe peripheral nodes only share a few connections.

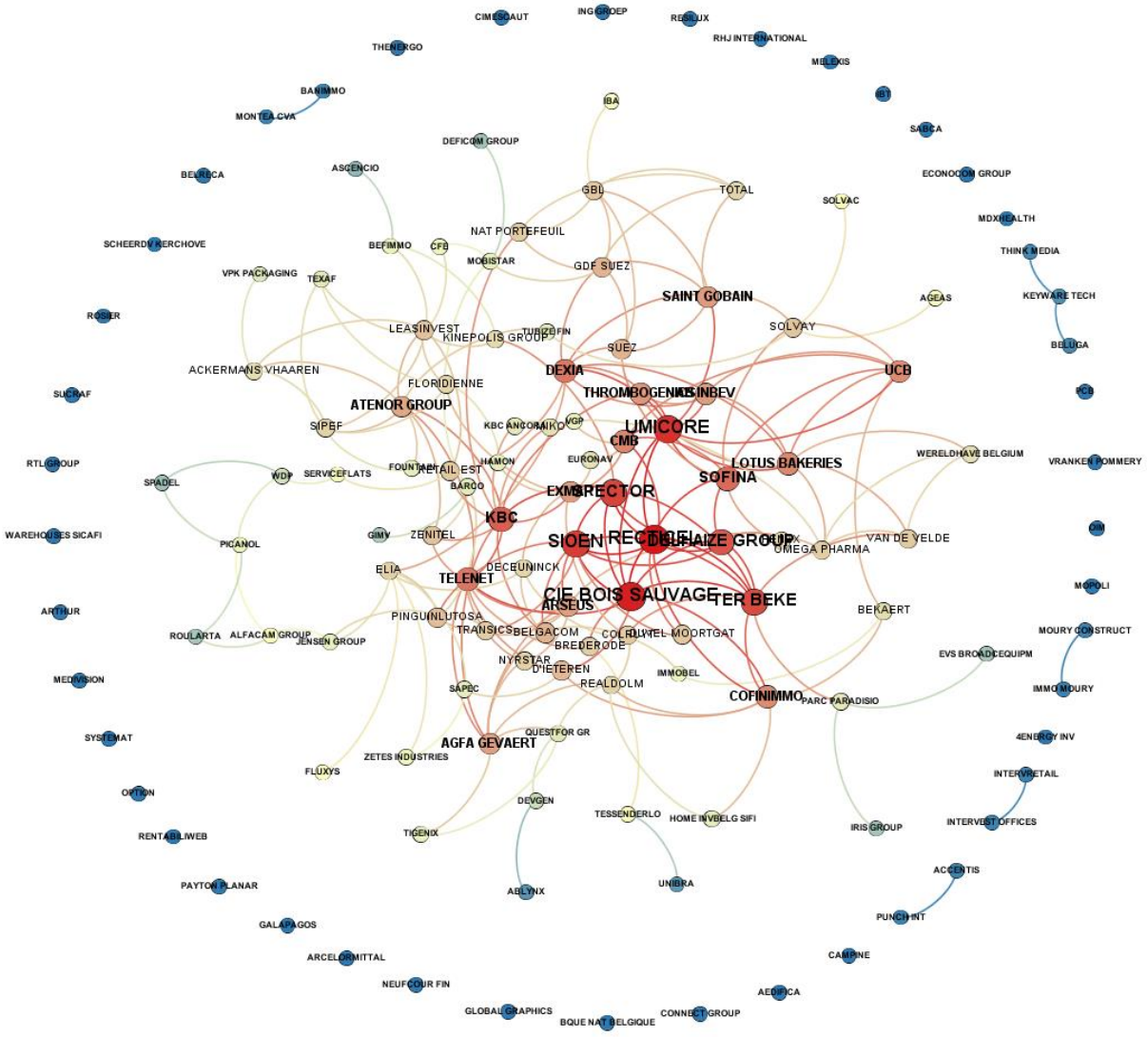

Figure 15 Network of boards for 2011 including singletons (Force Atlas algorithm)

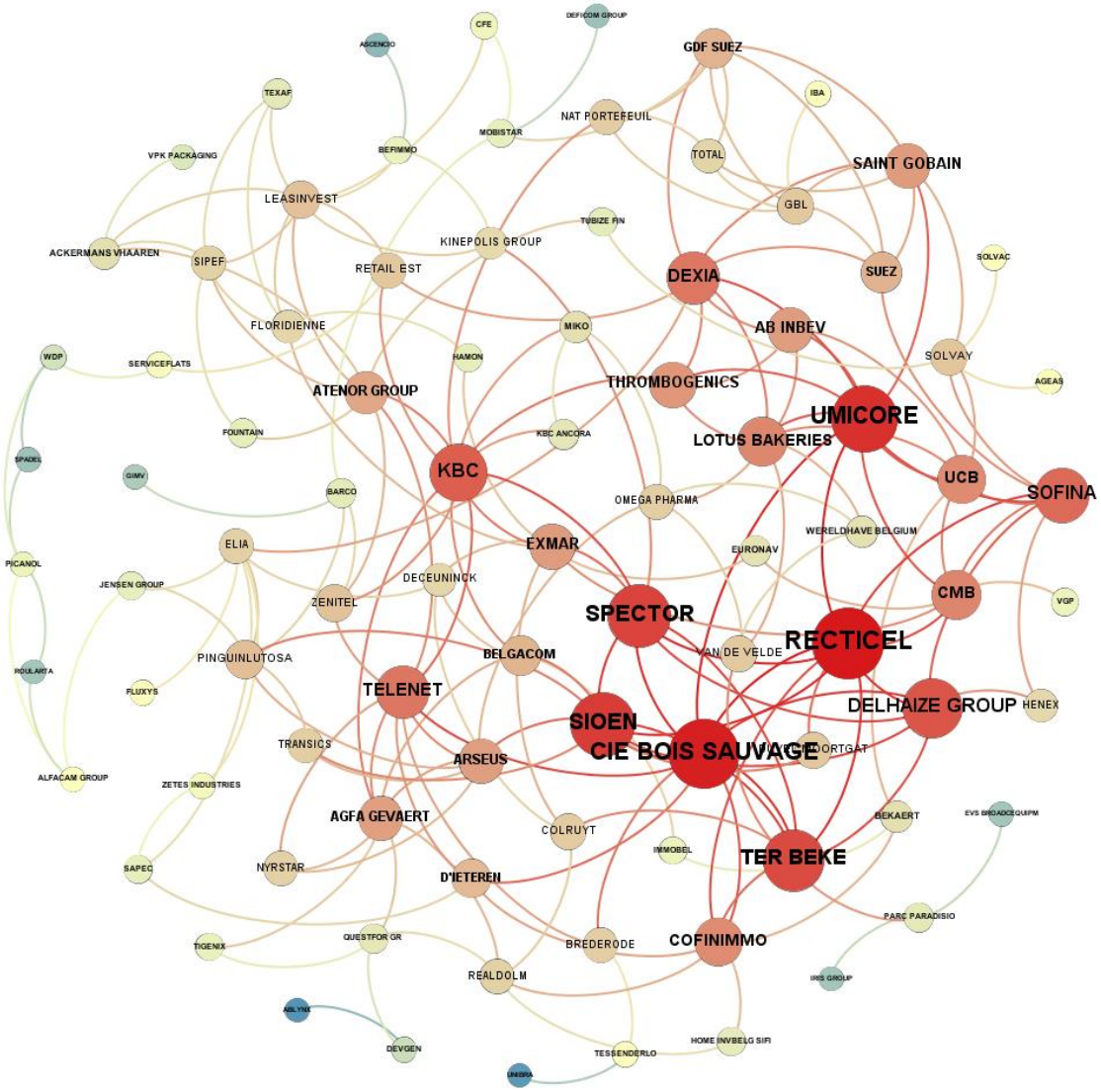

Figure 16 Network of boards for 2011 excluding singletons (Fruchterman Reingold algorithm)

A better view of the largest component of the 2011 board network is given in Figure 16.

Table 7: Characteristics of network of boards (2016)

	Entire Network	*Largest Component*
Number of Firms	142	102
Number of Links	175	170
Average Degree	2.46	3.33
Maximum Degree	11	11
Number of isolated nodes	30	
Number of components	36	
Component ratio	0.25	

The same analysis is performed for the network of boards of 2016. The main characteristics of the network are given in Table 7. Comparing these characteristics with those of the network of 2011 we see that, although the number of nodes has slightly increased, the number of edges has decreased. This means that in the interval of five years, the ties connecting the boards to each other have diminished and that less and less directors tend to have more than one directorship.

Again, the network is visually inspected in Figure 17 and Figure 18. As we observe the network of the boards of directors, we clearly see that the low density of previous network is also outspoken in this network. There are also a large number of singletons and dyads that do not have any ties to the rest of the network, like it is the case for the 2011 network.

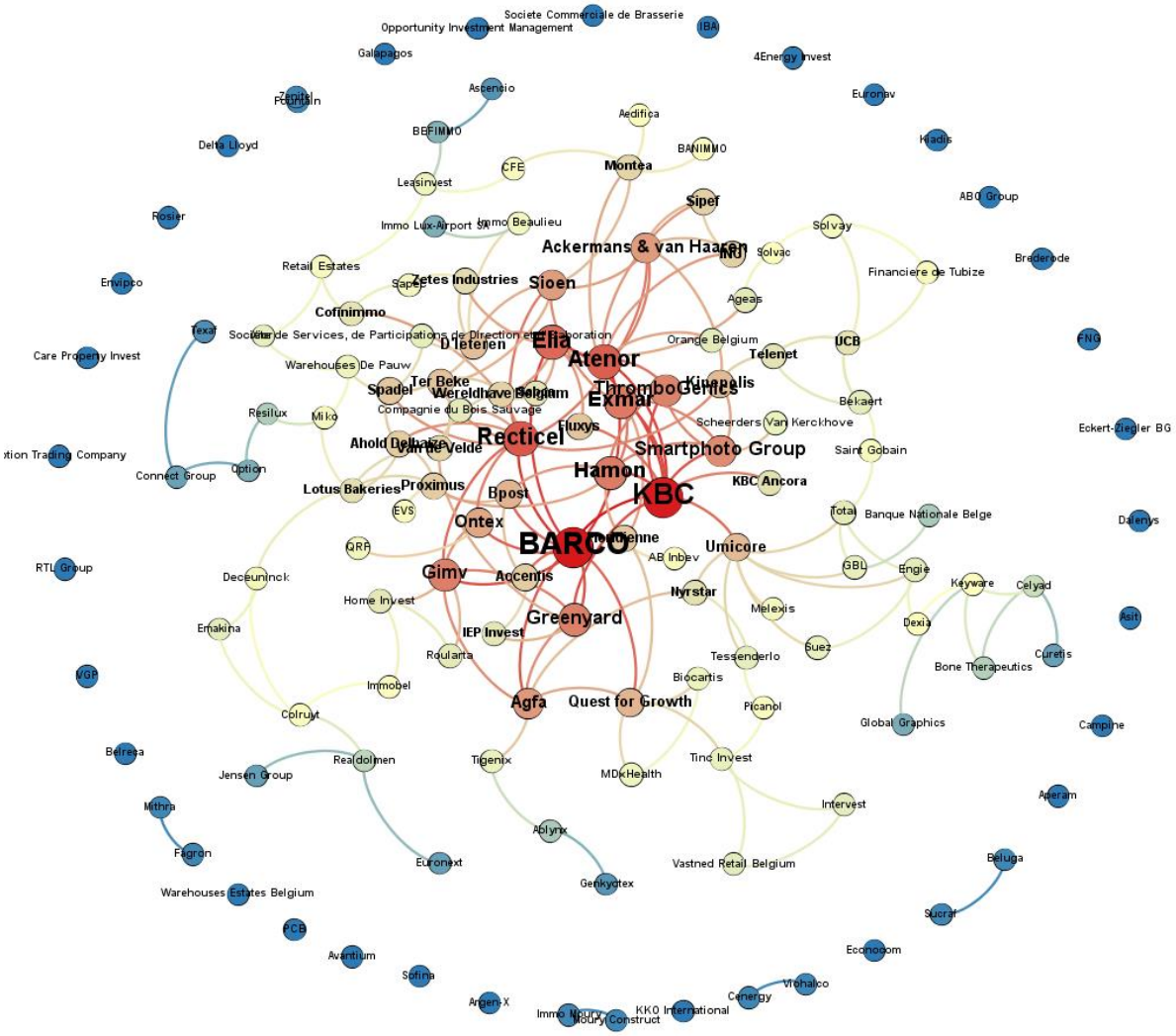

Figure 17 Network of boards for 2016 including singletons (Force Atlas algorithm)

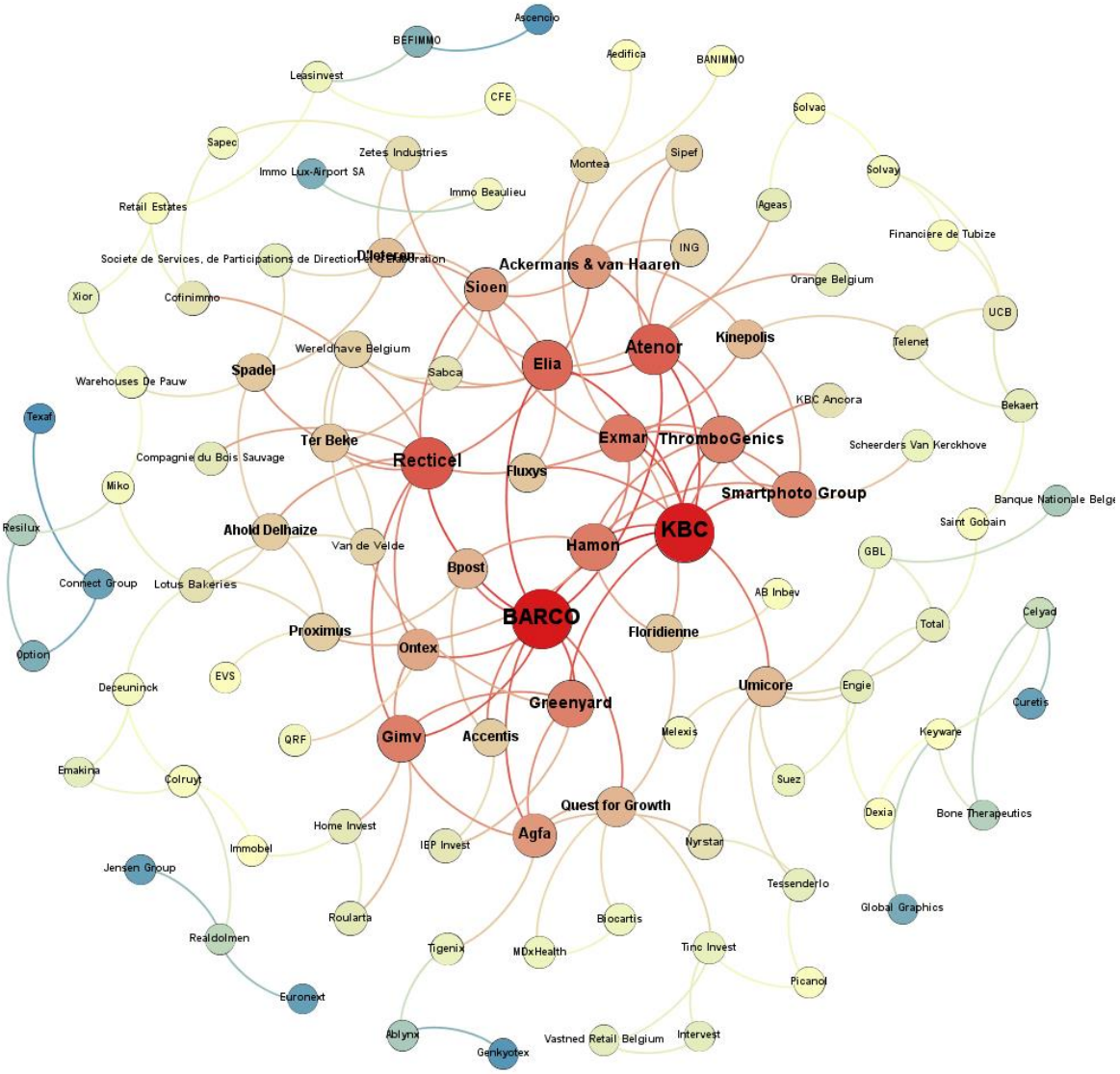

Figure 18 Network of boards for 2016 excluding singletons (Fruchterman Reingold algorithm)

6.1.1.2 Social Network Measures

After the construction of the network, the main centrality measures, Degree Centrality, Closeness Centrality, Betweenness Centrality and Eigenvector Centrality are computed using *Netminer*. The results of the boards with the highest centralities for each measure are benchmarked in Table 8. We see that the Degree and Eigenvector measures are comparatively stable over time, while the Closeness decreased and the Betweenness increased.

The companies that had a central board also tend to keep this central position over time.

Table 8 Most Central Companies

No.	*Name*	C_D	*Name*	C_C	*Name*	C_B	*Name*	C_E
Panel A: Top 10 *Degree*, *Closeness*, *Betweenness* and *Eigenvector Centrality* for 2011 in Percent								
1	KBC	11.88%	KBC	35.17%	KBC	15.95%	RECTICEL	33.15%
2	CIE BOIS SAUVAGE	9.90%	TELENET	33.00%	DEXIA	8.57%	CIE BOIS SAUVAGE	31.38%
3	RECTICEL	9.90%	SPECTOR	32.60%	ATENOR GROUP	8.35%	SIOEN	27.34%
4	SIOEN	9.90%	CIE BOIS SAUVAGE	32.47%	RETAIL EST	7.89%	UMICORE	27.03%
5	UMICORE	9.90%	RECTICEL	31.57%	TELENET	7.67%	TER BEKE	26.16%
6	DEXIA	8.91%	EXMAR	31.45%	AGFA GEVAERT	7.15%	SPECTOR	25.97%
7	LEASINVEST	8.91%	SIOEN	31.33%	TER BEKE	7.13%	DELHAIZE GROUP	25.11%
8	TELENET	8.91%	UMICORE	31.21%	ELIA	7.09%	SOFINA	20.62%
9	TER BEKE	8.91%	DEXIA	31.21%	LEASINVEST	6.67%	KBC	17.28%
10	AGFA GEVAERT	7.92%	RETAIL EST	30.73%	EXMAR	6.62%	CMB	16.85%
Panel B: Top 10 *Degree*, *Closeness*, *Betweenness* and *Eigenvector Centrality* for 2016 in Percent								
1	BARCO	10.00%	BARCO	29.90%	KBC	21.18%	KBC	36.84%
2	KBC	10.00%	KBC	29.33%	UMICORE	18.45%	BARCO	36.66%
3	RECTICEL	10.00%	RECTICEL	28.86%	RECTICEL	17.92%	ATENOR GROUP	26.36%
4	ELIA	8.18%	ELIA	27.38%	BARCO	16.80%	RECTICEL	24.57%
5	ATENOR GROUP	7.27%	GREENYARD	26.58%	LOTUS BAKERIES	11.76%	ELIA	24.14%
6	UMICORE	7.27%	EXMAR	26.43%	ELIA	11.23%	EXMAR	22.11%
7	EXMAR	6.36%	GIMV	26.43%	ENGIE	9.46%	HAMON	21.99%
8	GIMV	6.36%	HAMON	26.35%	QUEST for GROWTH	8.76%	THROMBOGENICS	21.39%
9	HAMON	6.36%	ATENOR GROUP	25.97%	GIMV	8.31%	GREENYARD	20.64%
10	GREENYARD	5.45%	AGFA	25.83%	DEXIA	7.92%	GIMV	20.40%

These main statistics of these firm centralities are given in Table 9.

Table 9 Normalized Firm centrality

Variable	*Mean*	*Median*	*Lowest Decile*	*Highest Decile*	*SD*
Panel A: Firm Centrality for 2011 in Percent					
Degree Centrality	2.27%	2.97%	0.99%	7.92%	2.76%
Closeness Centrality	6.08%	24.60%	1.52%	30.55%	8.49%
Betweenness Centrality	2.06%	1.27%	0.00%	6.51%	2.73%
Eigenvector Centrality	5.67%	3.69%	0.00%	16.83%	7.65%
Panel B: Firm Centrality for 2016 in Percent					
Degree Centrality	1.53%	1.82%	0.91%	5.45%	2.05%
Closeness Centrality	5.10%	19.76%	10.73%	25.62%	6.93%
Betweenness Centrality	2.93%	1.33%	0.00%	7.65%	4.11%
Eigenvector Centrality	5.72%	1.94%	0.00%	18.93%	7.79%

6.1.2 Directors Networks

The exact same analysis is now performed on the networks of directors, without taking into account the different firms. A tie is formed if two directors share the same board.

6.1.2.1 Visual Inspection

We start this analysis with the network of directors of 2011. The data of this network is given in Table 10.

Table 10: Characteristics of the network of directors (2011)

	Entire Network	*Largest Component*
Number of Directors	1027	731
Number of Links	5630	4679
Average Degree	10.96	12.80
Maximum Degree	59	59
Number of isolated nodes	0	
Number of components	41	
Component ratio	0.04	

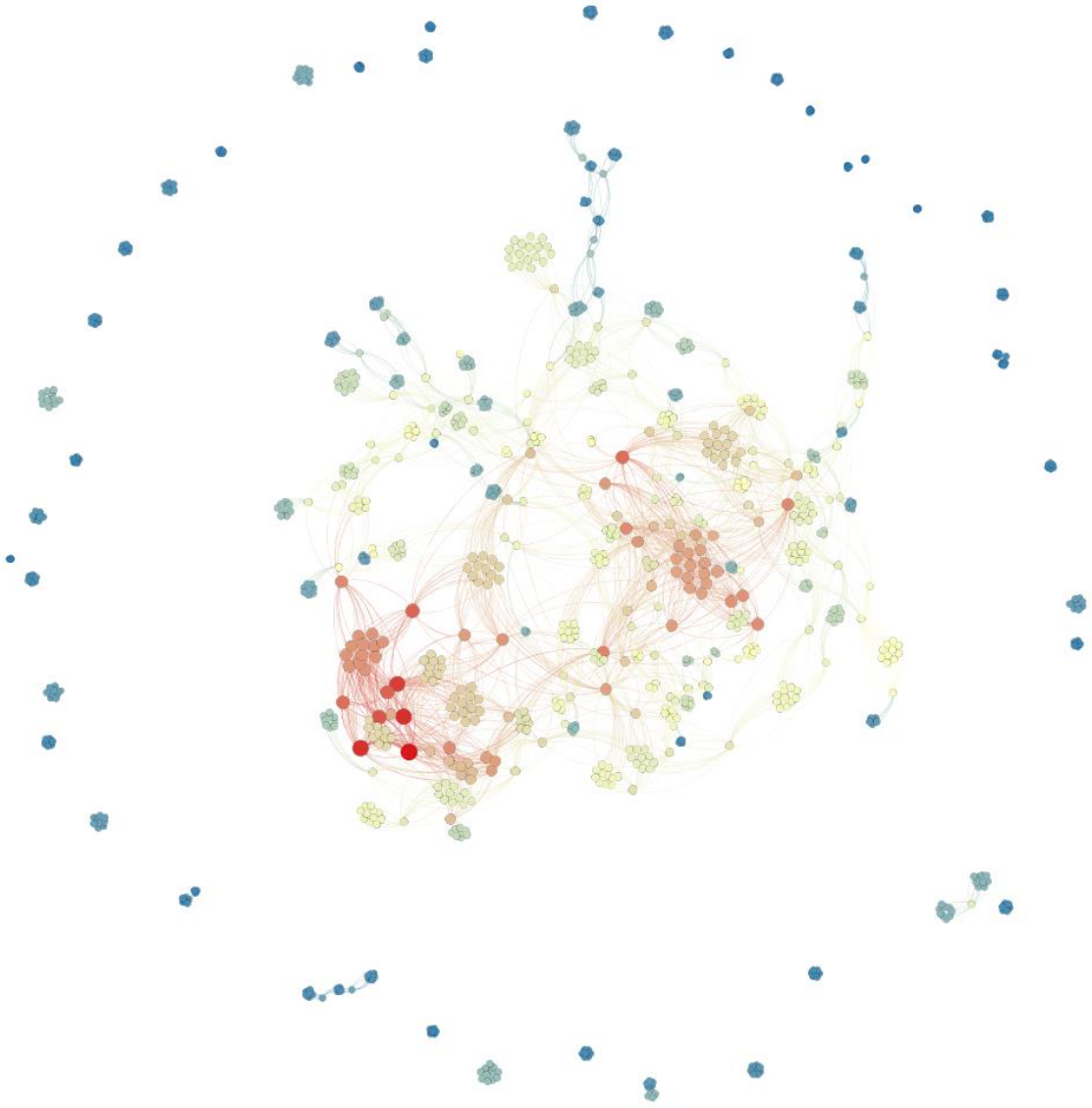

Figure 19: Network of directors for 2011 (Yifan Hu Algorithm)

The network displayed in Figure 19 represents the ties between the different individual directorships. The visual display was computed using the Yifan Hu Proportional algorithm. The sample of directors yields a total of 1,027 directors and 5,630 connections between them. The network comprises a central cluster surrounded by a large number of cliques not connected to the central cluster. The red nodes depict the directors with the highest Eigenvector Centrality. The largest component is isolated in Figure 20 for further analysis.

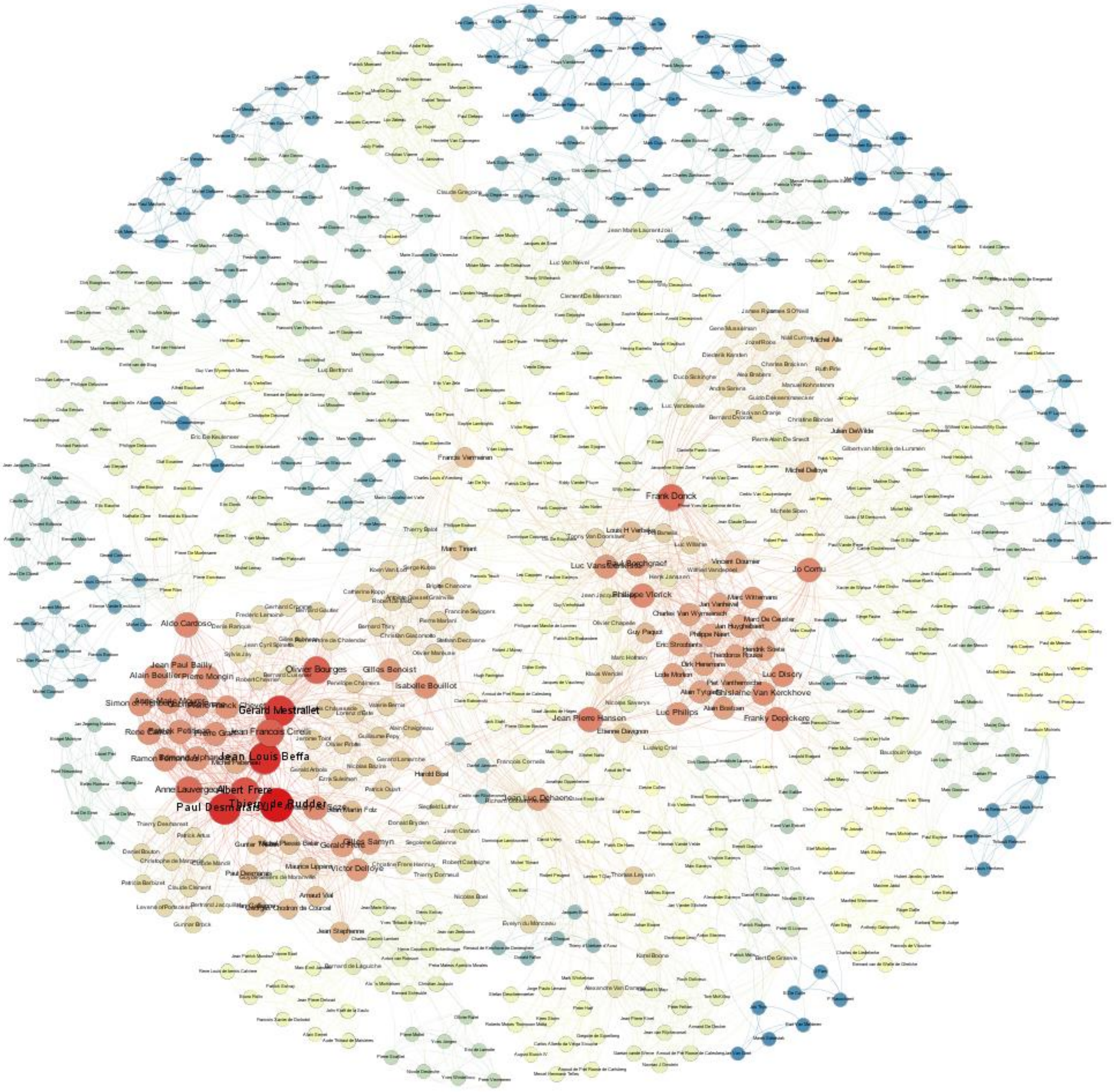

Figure 20: Network of directors for 2011 excluding nodes not connected to the central core (Fruchterman Reingold algorithm)

Table 11: Characteristics of the network of directors (2016)

	Entire Network	*Largest Component*
Number of Directors	1134	853
Number of Links	6119	5044
Average Degree	10.79	11.83
Maximum Degree	49	49
Number of isolated nodes	0	
Number of components	36	
Component ratio	0.03	

The analysis is continued with the network of directors of 2016. The main characteristics of the network are given in Table 11. These are very similar to those of 2011. The notable difference is the increase in the number of directors and the number of connections. This is logical, as the number of companies in the sample also increased.

Additionally, histograms of the distribution of the degree and weighted degree are given in Figure 21 and Figure 22. The graphs for 2011 are almost identical and were therefore omitted. Again, the distribution of the degree indicates that only a few directors have a large number of connections. The weighted degree indicates how many board appointments each director has and gives us the same conclusion.

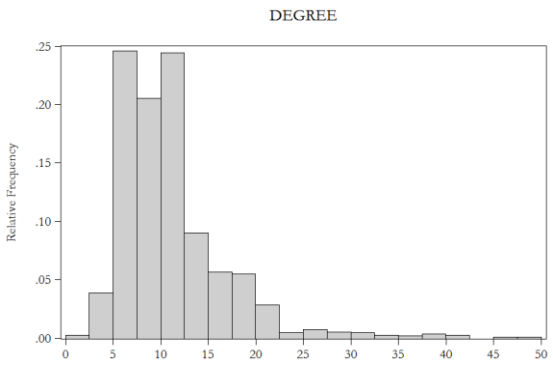

Figure 21: Distribution of the degree, network of directors (2016)

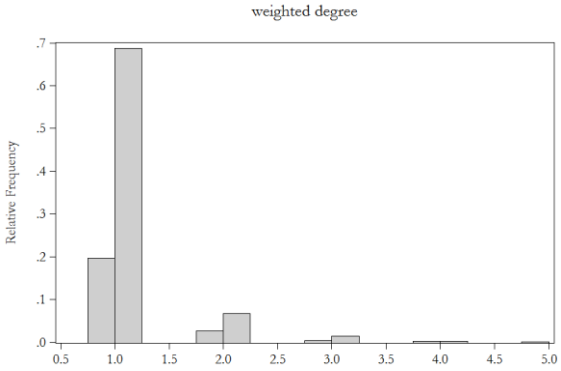

Figure 22: Distribution of the weighted degree, network of directors (2016)

The network is depicted in Figure 23 and Figure 24. Comparing it to the network of 2011, the network appears rather similar, with a central core and a number of unconnected boards around it. The difference is that it appears less clustered with more distance between the different boards.

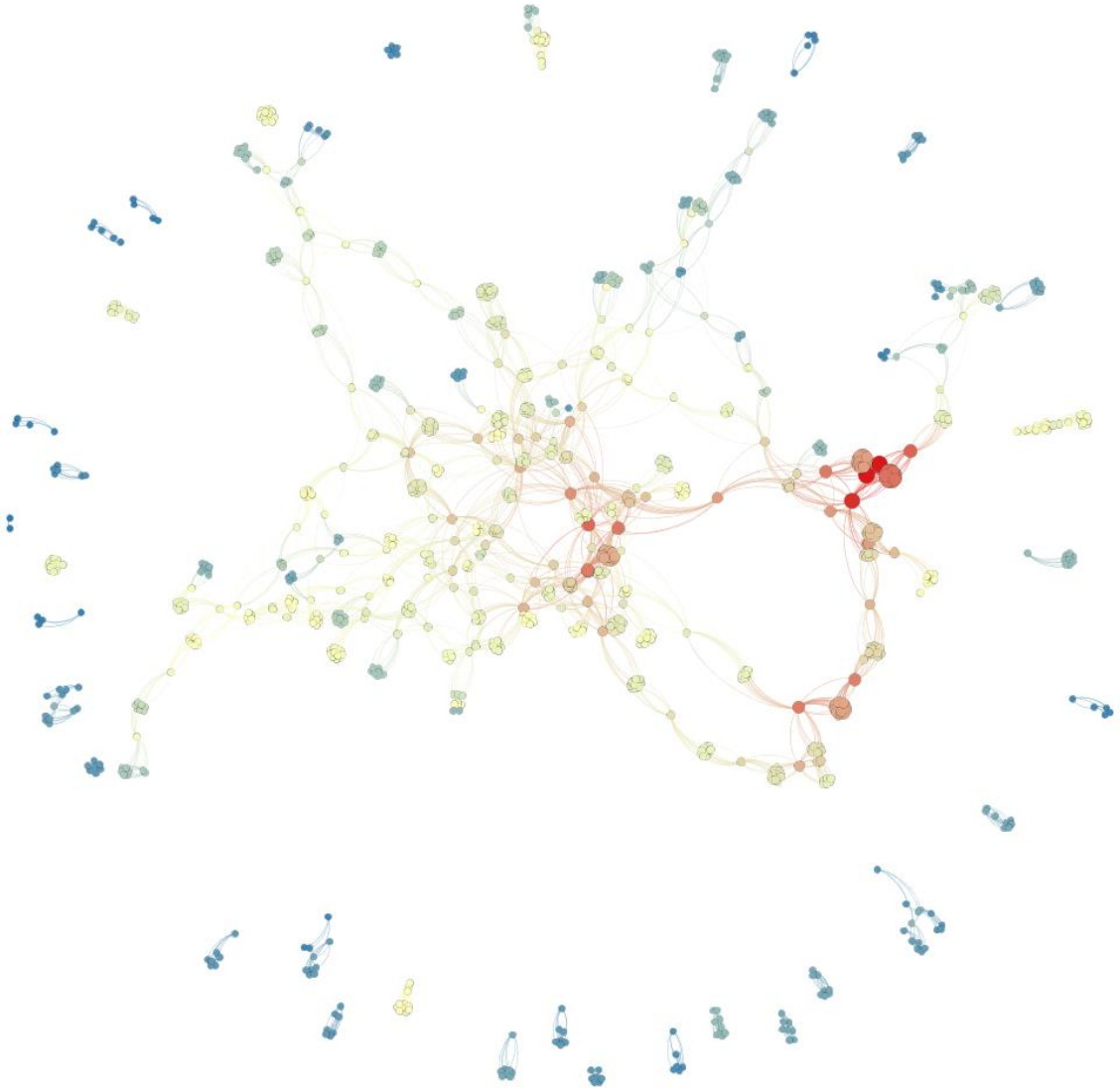

Figure 23: Network of directors for 2016 (Yifan Hu algorithm)

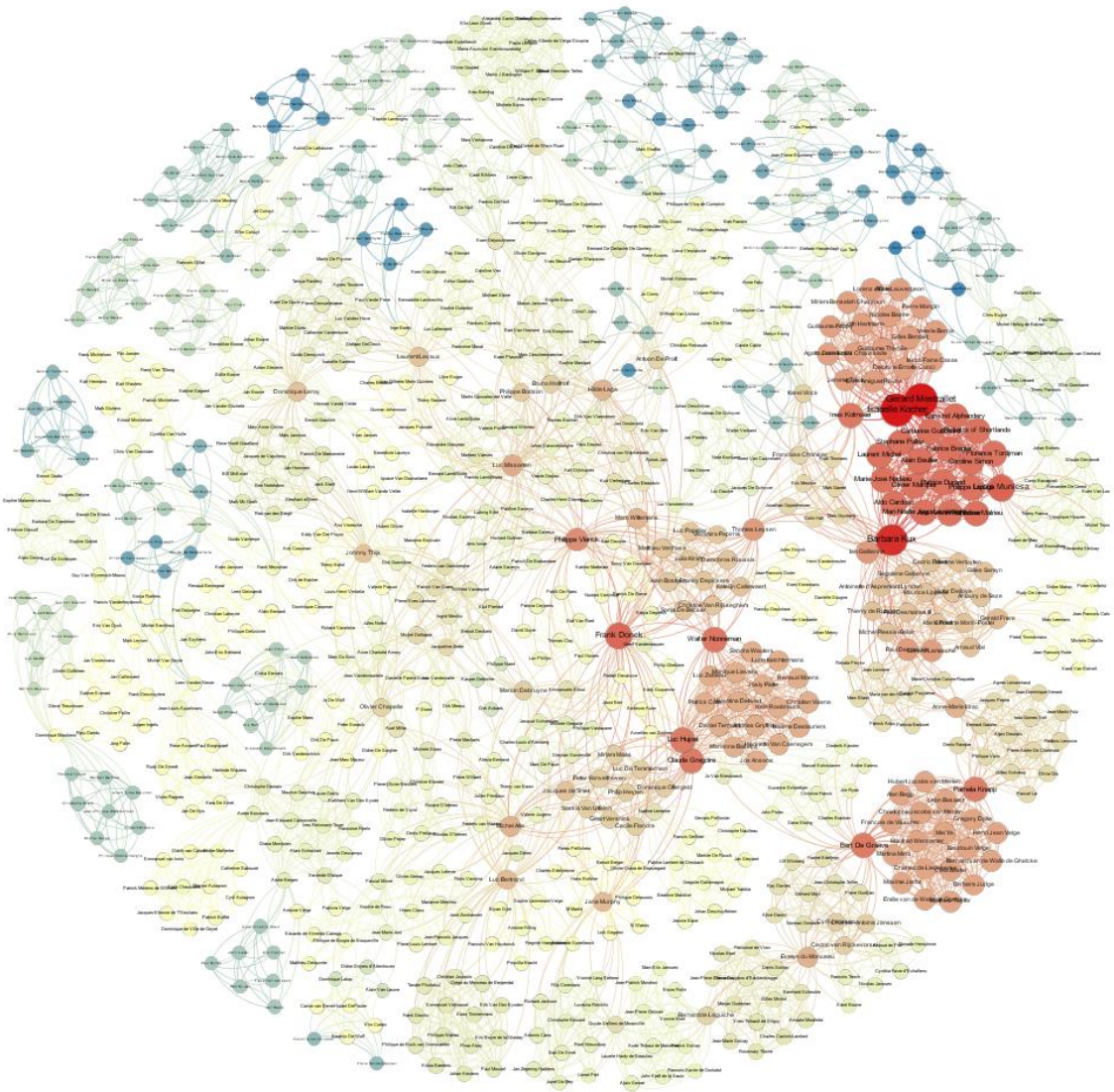

Figure 24: Network of boards for 2016 excluding nodes not connected to the central core (Fruchterman Reingold algorithm)

6.1.2.2 Social Network Measures

At last, the results of the directors with the highest centralities for each measure are benchmarked in Table 8. We see that, apart from the Betweenness Centrality, all other measures are comparatively constant over time.

Table 12: Most central directors (Unbalanced network)

No.	*Name*	C_D	*Name*	C_C	*Name*	C_B	*Name*	C_E
Panel A: Top 10 *Degree*, *Closeness*, *Betweenness* and *Eigenvector Centrality* for 2011 in Percent								
1	Jean Luc Dehaene	5.17%	Frank Donck	23.43%	Frank Donck	6.42%	Thierry de Rudder	29.16%
2	Thierry de Rudder	4.97%	Luc Vansteenkiste	23.34%	Luc Vansteenkiste	5.36%	Paul Desmarais Jr	26.65%
3	Frank Donck	4.87%	Philippe Vlerick	23.09%	Jo Cornu	4.59%	Jean Louis Beffa	25.85%
4	Gerard Mestrallet	4.78%	Jean Luc Dehaene	22.82%	Jean Luc Dehaene	4.28%	Gerard Mestrallet	22.89%
5	Luc Vansteenkiste	4.68%	Jo Cornu	22.64%	Luc Vandewalle	4.21%	Albert Frere	22.43%
6	Jean Louis Beffa	4.39%	Paul Borghgraef	22.44%	Luc Van Nevel	4.05%	Jean Francois Cirelli	19.36%
7	Jo Cornu	4.19%	Isabelle Bouillot	22.20%	Francis Vermeiren	3.78%	Anne Lauvergeon	19.20%
8	Paul Desmarais Jr	4.19%	Luc Philips	22.09%	Michel Akkermans	3.58%	Olivier Bourges	17.17%
9	Philippe Vlerick	3.90%	Guy Paquot	22.02%	Luc Bertrand	3.53%	Aldo Cardoso	14.99%
10	Isabelle Bouillot	3.80%	Jean Pierre Hansen	21.73%	Julien DeWilde	3.52%	Edmond Alphandery	14.53%
Panel B: Top 10 *Degree*, *Closeness*, *Betweenness* and *Eigenvector Centrality* for 2016 in Percent								
1	Philippe Vlerick	4.24%	Frank Donck	22.30%	Frank Donck	13.60%	Gerard Mestrallet	27.43%
2	Frank Donck	4.06%	Philippe Vlerick	21.59%	Thomas Leysen	12.95%	Isabelle Kocher	27.43%
3	Barbara Kux	3.71%	Luc Missorten	21.46%	Barbara Kux	9.82%	Barbara Kux	21.04%
4	Bert De Graeve	3.62%	Thomas Leysen	20.57%	Philippe Vlerick	9.79%	Lucie Muniesa	18.68%
5	Luc Bertrand	3.44%	Marc Wittemans	20.54%	Luc Missorten	8.30%	Ann-Kristin Achleitner	17.86%
6	Luc Missorten	3.35%	Hilde Laga	20.36%	Michel Delbaere	7.36%	Edmond Alphandery	17.86%
7	Gerard Mestrallet	3.27%	Bruno Holthof	19.68%	Marion Debruyne	5.51%	Fabrice Bregier	17.86%
8	Isabelle Kocher	3.27%	Michel Delbaere	19.67%	Hilde Laga	5.41%	Aldo Cardoso	17.86%
9	Hilde Laga	3.27%	Antoon De Proft	19.64%	Bert De Graeve	5.22%	Francoise Malrieu	17.86%
10	Dominique Leroy	3.09%	Walter Nonneman	19.58%	Lucie Muniesa	5.06%	Marie-Jose Nadeau	17.86%

6.1.3 Rebalancing the network

6.1.3.1 The Anomally

Observing the network and analysing the results, something seems off. The eigenvector centrality in particular appears to exhibit high values for directors whose respective boards have a lower eigenvector centrality when observing the network of boards. Taking a closer look at the network of directors for 2016, all the directors exhibiting the anomaly are located in a cluster that appears in the visual periphery of the network. The anomaly is illustrated in Figure 25.

Taking a closer look at the characteristics of these directors, the two most central directors, relative to the Eigenvector Centrality, Gerard Mestrallet and Isabelle Kocher, both are members

of the Suez and Engie boards, while these boards are not in the highest quintile when it comes to Eigenvector Centrality. Furthermore, the directors ranked from the fifth to the 21st place are all part of the Engie board and do not have external directorships.

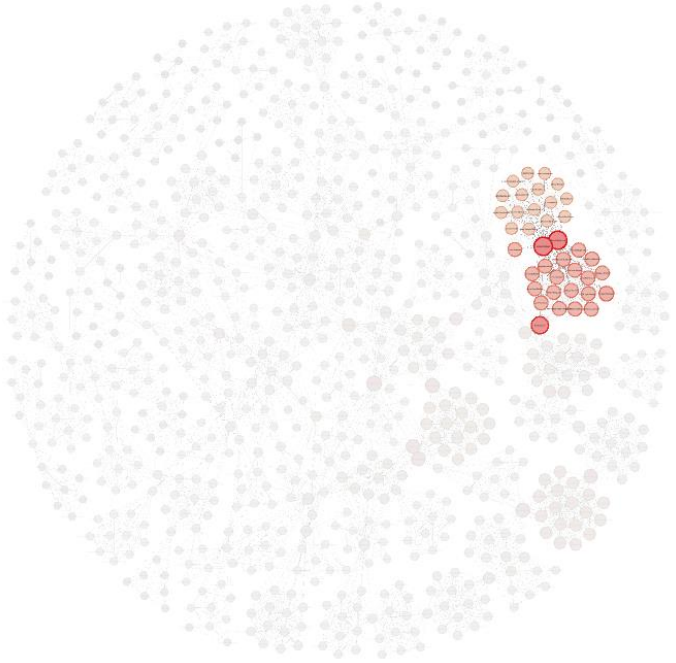

Figure 25: Location of the directors with the highest Eigenvector Centrality (2016)

6.1.3.2 The probable cause

Why do these peripheral directors exhibit such a high Eigenvector Centrality? Before finding the root cause of the problem, one must keep in mind that the theory of social network analysis was created to analyse social networks formed from individuals, and does not incorporate the particularities of boards of directors. First of all, the definition of Eigenvector Centrality must be reformulated. The eigenvector centrality provides a representation of the importance of a node inside a network. This means that the Eigenvector Centrality of a node is influenced by the Eigenvector Centrality of the adjacent nodes, such that a node that is connected to a high number of other well-connected nodes will have a higher Eigenvector Centrality. This will on his turn increase the Eigenvector Centrality of the adjacent nodes. This feedback triggers what can be called a snowball effect, where large clusters have a high Eigenvector Centrality and nodes in smaller clusters see it decrease.

This effect is meant to be the case in usual social networks, but is further increased with networks of directors. Networks of directors form clusters of directors according to the companies that are part of the network. What makes this case so particular is that the Eigenvector Centrality does not take into account the varying number of directors on each specific board. This means that boards with a large number of directors will exhibit a higher Eigenvector Centrality, compared to boards with a lower count. This is caused by the snowball effect mentioned prior. Figure 26 illustrates this effect.

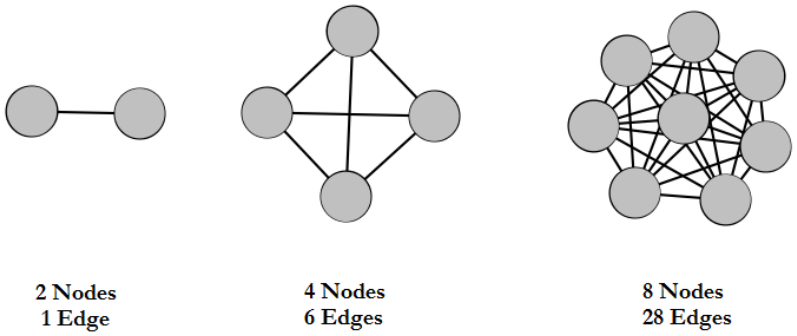

Figure 26: Representation of the snowball effect

With each additional director on the board, the number of internal connections increases dramatically[6]. Subsequently, this higher number of connections will increase the Eigenvector Centrality of the nodes. In this case, it would be possible to increase the Eigenvector Centrality, by adding directors that do not have external connections. This violates the assumption that each company should have the same weight inside the network, as is the case in the network of boards. Logically, smaller and larger boards should all have the same weight to have a fair representation of the network's Eigenvector Centrality.

This theory appears to be confirmed by the empirical data, as the directors exhibiting this higher Eigenvector Centrality are located on boards with a director count much higher than average. The average board in the network has approximately 9 directorships, resulting in 36 internal connections, while the Engie board amounts for 21 directorships, resulting in 210 internal connections. This suggests an internal connection count almost 6 times higher than the average board[7].

[6] The amount of connections inside a board is given by: $Number\ of\ Connections = \sum_{i=1}^{N}(i-1)$, with N being the number of directors on the board.

[7] It must be noted that the theory will not be further tested, as this falls out of the purpose of this Master's Thesis.

6.1.3.3 Remediation to the anomaly

No example that mentions this anomaly was found in the academic literature. Andres, van den Bongard, & Lehmann (2013) do calculate statistics from networks of directors, but without mentioning the anomaly.

How to remediate the anomaly? Some solutions are conceivable. The first possible solution would be to exclude boards with a too large number of directors from the calculations. The main advantage would be that these directors do not influence the calculations anymore. Unfortunately, the disadvantages largely outweigh the advantages. The first major disadvantage is the difficulty to find the right threshold for the cut-off. From which value would a board be considered too large? Using a definite percentile could solve help, but the question still remains. The other major disadvantage would be that the distorted network would not represent reality anymore, as some parts of it would have been left out. Furthermore, the remaining boards would still exhibit differences in the number of directorships, so the problem would still be intact. Because of all these disadvantages, this solution will not be implemented.

The other plausible solution would be to make use of weighted edges. As of now; each edge has an equivalent weight of 1. The new configuration of weights should give each board the same importance, independently of the number of directorships it is constituted of. To obtain this result, the following formula is used[8]:

$$w = \frac{1}{N-1}$$

As a result, the sum of weights arriving to one director and coming from the directors of the same board equals one, as illustrated in Figure 27. It is not a function of the number of directors on a board anymore. Obviously, this solution will be used to rebalance the network.

[8] w being the weight of the edge and N being the number of directors inside the board.

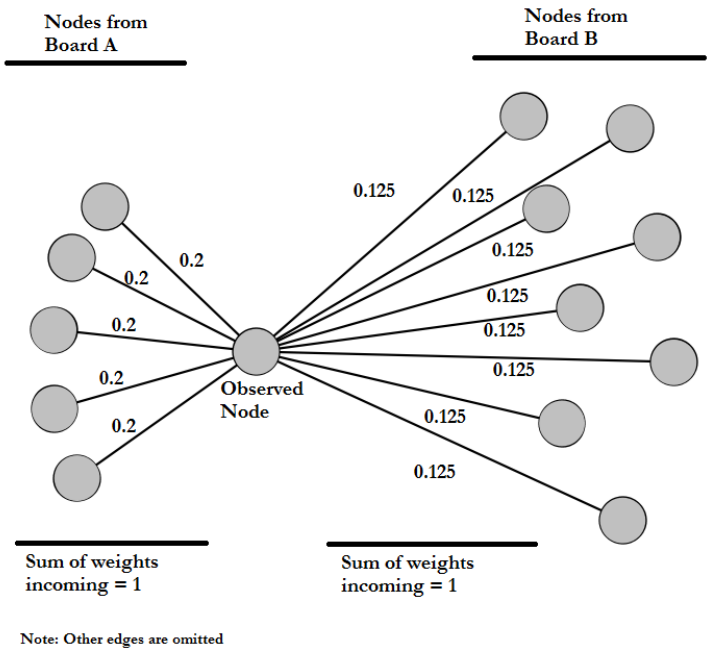

Figure 27: Example of weighted edges

The computer program designed to generate the list of edges was rewritten to accommodate the additional calculation of weights. This script can be found in Appendix 1. The newly recalculated centralities for both the 2011 and 2016 networks are given in Table 13. The Degree Centrality, Closeness Centrality, and Betweenness Centrality do not change, as they are not influenced by the edge weights in their calculations. As expected, the Eigenvector Centrality is greatly influenced by the rebalancing of the network. The now more central directors from the point of view of the Eigenvector centrality do come from boards with a lesser amount of directors, and that are "visually" more central.

Finally, a choice has to be made, whether the centrality measures for the network of boards or those for the network of directors are to be used in the upcoming regression analysis. Due to this anomaly, the use of the centralities of the networks of directors will not be used for the later regressions, even the values for the balanced network. It seems too risky too use these values, as the anomaly could affect the results. Instead, the centrality measures of the network of boards will be used, as it is the case in Schonlau & Singh(2009), as well as in Larcker, So, & Wang (2013)

Table 13: Most central directors (balanced network)

No.	*Name*	C_D	*Name*	C_C	*Name*	C_B	*Name*	C_E
Panel A: Top 10 *Degree*, *Closeness*, *Betweenness* and *Eigenvector Centrality* for 2011 in Percent								
1	Jean Luc Dehaene	5.17%	Frank Donck	23.43%	Frank Donck	6.42%	Luc Vansteenkiste	40.43%
2	Thierry de Rudder	4.97%	Luc Vansteenkiste	23.34%	Luc Vansteenkiste	5.36%	Vincent Doumier	28.61%
3	Frank Donck	4.87%	Philippe Vlerick	23.09%	Jo Cornu	4.59%	Louis H Verbeke	27.19%
4	Gerard Mestrallet	4.78%	Jean Luc Dehaene	22.82%	Jean Luc Dehaene	4.28%	Guy Paquot	23.70%
5	Luc Vansteenkiste	4.68%	Jo Cornu	22.64%	Luc Vandewalle	4.21%	Wilfried Vandepoel	22.42%
6	Jean Louis Beffa	4.39%	Paul Borghgraef	22.44%	Luc Van Nevel	4.05%	Luc Willame	20.56%
7	Jo Cornu	4.19%	Isabelle Bouillot	22.20%	Francis Vermeiren	3.78%	Pol Bamelis	20.44%
8	Paul Desmarais Jr	4.19%	Luc Philips	22.09%	Michel Akkermans	3.58%	Tonny Van Doorslaer	16.85%
9	Philippe Vlerick	3.90%	Guy Paquot	22.02%	Luc Bertrand	3.53%	Etienne Davignon	15.48%
10	Isabelle Bouillot	3.80%	Jean Pierre Hansen	21.73%	Julien DeWilde	3.52%	Klaus Wendel	15.02%
Panel B: Top 10 *Degree*, *Closeness*, *Betweenness* and *Eigenvector Centrality* for 2016 in Percent								
1	Philippe Vlerick	4.24%	Frank Donck	22.30%	Frank Donck	13.60%	Axel Miller	42.79%
2	Frank Donck	4.06%	Philippe Vlerick	21.59%	Thomas Leysen	12.95%	Anne-Charlotte Amory	39.49%
3	Barbara Kux	3.71%	Luc Missorten	21.46%	Barbara Kux	9.82%	Marc Du Bois	39.49%
4	Bert De Graeve	3.62%	Thomas Leysen	20.57%	Philippe Vlerick	9.79%	Jean Vandemoortele	36.04%
5	Luc Bertrand	3.44%	Marc Wittemans	20.54%	Luc Missorten	8.30%	Johnny Thijs	24.87%
6	Luc Missorten	3.35%	Hilde Laga	20.36%	Michel Delbaere	7.36%	Frank Meysman	23.52%
7	Gerard Mestrallet	3.27%	Bruno Holthof	19.68%	Marion Debruyne	5.51%	Didier De Sorgher	22.97%
8	Isabelle Kocher	3.27%	Michel Delbaere	19.67%	Hilde Laga	5.41%	Roland Vaxeleire	20.36%
9	Hilde Laga	3.27%	Antoon De Proft	19.64%	Bert De Graeve	5.22%	Pascal Minne	9.08%
10	Dominique Leroy	3.09%	Walter Nonneman	19.58%	Lucie Muniesa	5.06%	Michele Sioen	7.86%

The four measures of centrality for networks of directors in both 2011 and 2016 are given in Table 14. As expected, their distribution appears to be heavily skewed, as the mean values are largely lower than the maximum value. This means that a select number of directors are well-connected, while the large majority do not have any outside connections. Furthermore, both the balanced and unbalanced Eigenvector Centralities are analysed. It seems that the average and median values for the balanced network are a bit higher than they arefor the unbalanced network.

Table 14: Properties of the directors' centrality for both 2011 and 2017

Variable	*Mean*	*Median*	*Lowest Decile*	*Highest Decile*	*SD*
Panel A: Director Centrality for 2011 in Percent					
Degree Centrality	1.06%	0.88%	0.49%	1.95%	0.68%
Closeness Centrality	12.08%	15.38%	0.58%	19.45%	7.56%
Betweenness Centrality	0.17%	0.00%	0.00%	0.34%	0.61%
Eigenvector Centrality (Unbalanced)	0.91%	0.02%	0.00%	2.43%	2.98%
Eigenvector Centrality (Balanced)	1.08%	0.21%	0.00%	2.67%	2.93%
Panel B: Director Centrality for 2016 in Percent					
Degree Centrality	0.95%	0.79%	0.44%	1.59%	0.50%
Closeness Centrality	11.01%	13.31%	0.62%	17.25%	6.31%
Betweenness Centrality	0.22%	0.00%	0.00%	0.14%	1.00%
Eigenvector Centrality (Unbalanced)	0.63%	0.00%	0.00%	0.36%	2.90%
Eigenvector Centrality (Balanced)	0.67%	0.04%	0.00%	1.15%	2.89%

6.1.4 Small World Phenomenon

The final step in the analysis of the characteristics of the networks is investigating for small world properties. The procedure explained in Chapter „, is followed. The obtained results are given in Table 15 for the networks of boards and directors for both 2011 and 2016. A distinction is made between the largest component of a network (the central cluster) and the entire network. This is because some properties can only be computed on network for which all nodes are connected to each other.

The first quantity to be computed is the network density (ϱ), using equation 6. The first assumptions from the visual inspections are confirmed, as the network density is relatively low compared to usual social networks. This gives a first indication to the possible presence of small world properties, since a low network density is a typical characteristic of a small world network. Additionally, the network diameter (s) of the largest component is also relatively small, with a value of 8 for the network of boards and 9 for the network of directors. This is the longest possible finite geodesic path inside the network. A small network diameter is another clue for small world properties, but does not give a definitive

The procedure that should give a definitive answer whether the networks demonstrate the small world phenomenon is the calculation of the statistics of Watts and Strogatz (Sankowska & Siudak, 2016). First, equation 7 is used to compute the average shortest path length (L) and is compared to the value of a random network, obtained through equation 9. For the network of boards, the value of the actual network is close to the value of the random network, with L_{ACTUAL} being 3,67 and L_{RANDOM} = 3,09. The small world theory says this average shortest path length of a small worlds network should typically scale with log(N) (Sankowska & Siudak, 2016), so $L_{Small\ World}$ = log(91) = 1.91 for 2011 and $L_{Small\ World}$ = log(102) = 2.00 for 2016. This indicates that the value of the average shortest path length is a bit too high relative too small world properties with $L_{ACTUAL} > L_{RANDOM} > L_{Small\ World}$. This is also confirmed by λ, which gives the ratio between L_{ACTUAL} and L_{RANDOM}. Ideally the ratio would have to be lower than 1. This high average shortest path length indicates a speed of information transfer inside the network being lower than in networks with a lower average shortest path length.

The computation of the average shortest path length does not provide a definitive indication of small world characteristics of the different networks. The clustering coefficient (C) must still be

analysed. The calculation is done using equation 8. Observing the values obtained in Table 15, we see that C_{ACTUAL} is much larger than C_{RANDOM}, and therefore the ratio between the two values (γ^{WS}) to be much larger than one, $\gamma^{WS} >> 1$. This high tendency to form clusters is a typical indication of small world properties. The definitive decision is given by S^{SW}, which is the ratio between γ^{WS} and λ. As this value is larger than one, we can conclude that both the networks of boards and directors for 2011 and 2016 exhibit small world properties in the sense of Watts and Strogatz. This means that the average distance between two nodes of the maximal connected component is very small, and therefore the speed of information transfer is increased. (Battiston & Catanzaro, 2004)

Table 15: Small World properties for the board and director networks

Variable	Board		Directors	
	Entire network	Largest component	Entire network	Largest component
Panel A: Small-world quantities for 2011				
ϱ	0.022	0.048	0.011	0.018
s	-	8	-	9
L_{Actual}	3.67	3.67	4.35	4.36
L_{random}	-	3.09	-	2.59
C_{Actual}	0.42	0.42	0.93	0.91
C_{random}	-	0.047	-	0.018
C_{actual} / ϱ	19.19	8.79	84.82	50.61
γ^{WS}	-	8.91	-	52.0
λ	-	1.19	-	1.69
S^{WS}	-	**7.50**	-	**30.84**
Panel B: Small-world quantities for 2016				
ϱ	0.017	0.033	0.010	0.014
s	-	14	-	14
L_{Actual}	4.76	4.77	5.40	5.41
L_{random}	-	3.84	-	2.73
C_{Actual}	0.32	0.32	0.94	0.93
C_{random}	-	0.033	-	0.014
C_{actual} / ϱ	18.94	9.76	94.00	66.14
γ^{WS}	-	9.85	-	66.79
λ	-	1.24	-	1.98
S^{WS}	-	**7.94**	-	**33.72**

6.2 Multivariate Analysis

To be able to answer the second research question of this Master's Thesis this question is recapitulated:

Is the performance of Belgian companies influenced by Board Centrality?

A hypothesis was formed:

Board Centrality has a significant positive effect on firm performance.

This hypothesis is further deconstructed into four hypotheses which relate board centrality to firm performance:

H1: There exists a positive association between the Return on Assets of a company and its Board Centrality.

H2: There exists a positive association between the Tobin's Q of a company and its Board Centrality.

H3: There exists a positive association between the One-Year-Ahead change in Return on Assets of a company and its Board Centrality.

H4: There exists a positive association between the One-Year-Ahead change in Tobin's Q of a company and its Board Centrality.

Two types of data will be used for this analysis. The first two hypotheses will be tested on panel data. This means that the data contains information about multiple entities across different time periods. In this case the hypotheses will be tested on the normalized board centralities for both 2011 and 2016, with the firm data also being normalized to permit the comparison.

The last two hypotheses will exclusively be tested on cross-sectional data, meaning information about multiple entities, but for only one time period. The reason is that the annual reports for 2017 are not yet published as of the time of the writing of this Master's Thesis. Therefore one-year-ahead changes could not be computed for that time period.

The analysis technique used to test the aforementioned hypotheses is multiple regression analysis. This is a regression technique where the dependent variable depends on two or more independent variables and tests the relationship between these variables (Gujarati & Porter,

2009). The techniques will be executed following the recommendations in Gujarati & porter (2009).

The next step is to convert the theoretical relationship we expect into an empirical specification. Following the description of the different variables, the following functional forms are obtained:

For the first hypothesis:

$$ROA = \beta_0 + \beta_1 BC + \beta_2 * LBM + \beta_3 * Size + \beta_4 * Leverage + \beta_5 * Assets$$

The empirical specification is then formed by adding the error term μ:

$$ROA = \beta_0 + \beta_1 BC + \beta_2 * LBM + \beta_3 * Size + \beta_4 * Leverage + \beta_5 * Assets + \mu$$

BC stands for Board Centrality, this acronym will be replaced alternately by the proxies for board centrality, the quintiles for Degree Centrality, Closeness Centrality, Betweenness Centrality, and Eigenvector Centrality, and ultimately by the N-score. This means that the hypothesis will be tested five times: for all four centrality measures and for the measure integrating the overall well-connectedness.

For this specific example, the tested hypotheses are:

- H_0: $\beta_1 = 0$
- H_1: $\beta_1 \neq 0$

There is no need to test the other variables or to see if every variable have a significant explanatory power inside the model, as we are only interested in the effect of the board centrality on the firm performance.

The empirical specifications for the other regressions are:

$$Tobin's\ Q = \beta_0 + \beta_1 BC + \beta_2 * LBM + \beta_3 * Size + \beta_4 * Leverage + \beta_5 * Assets$$

$$\Delta ROA = \beta_0 + \beta_1 BC + \beta_2 * LBM + \beta_3 * Size + \beta_4 * Leverage + \beta_5 * Assets$$

$$\Delta Tobin's\ Q = \beta_0 + \beta_1 BC + \beta_2 * LBM + \beta_3 * Size + \beta_4 * Leverage + \beta_5 * Assets$$

The comments applying to the first regression also apply to these regressions. The outputs of all the regressions performed in this chapter can be found in Appendix 6.

Before performing the regressions, the model was tested for a number of assumptions. The model was investigated for multicollinearity by checking the correlation matrixes (Appendix 7).

The correlation between the explanatory variables is rather low, so we expect no multcollinearity problems. Additionally, a White's test was performed to investigate possible heteroscedasticity. Unfortunately, heteroscedasticity seems to be present in the model. A Model Transformation seems difficult to implement since we estimate a multivariate model. By using White's heteroscedastic variance, we conclude that the heteroscedasticity does not have a big impact on our model and that we do not have to worry about it.

The next step is to investigate the correlation matrices between the dependent variables and the centrality measures. From the tables below, we see that the relationship between those variables is rather weak. We then perform the regressions to investigate this relationship further.

Table 16: Correlation matrix between different variables

	Degree Centrality	Closeness Centrality	Betwenness Centrality	Eigenvector Centrality	Tobin's Q	Return On Assets
Degree Centrality	1					
Closeness Centrality	0.926	1				
Betwenness Centrality	0.836	0.715	1			
Eigenvector Centrality	0.901	0.962	0.699	1		
Tobin's Q	-0.059	-0.0795	0.00963	-0.0151	1	
Return On Assets	0.111	0.103	0.0967	0.111	0.286	1

Table 17: Correlation matrix with the quintiles of the centrality measures

	Quint (Degree Centrality)	Quint (Closeness Centrality)	Quint (Betweenness Centrality)	Quint (Eigenvector Centrality)	Tobin's Q	Return On Assets
Quint(Degree Centrality)	1					
Quint(Closeness Centrality)	0.895	1				
Quint(Betweenness Centrality)	0.844	0.738	1			
Quint(Eigenvector Centrality)	0.8801	0.959	0.686	1		
Tobin's Q	0.0747	0.0198	0.07101	0.00896	1	
Return On Assets	-0.00237	-0.0274	-0.000189	-0.0335	0.286	1

The first group of regressions is performed using the ordinary least squares method. We examine whether there is an association between the firm's operating profitability and its board centrality. Table 18 provides the results of the regression of the firms' return on assets on their network centralities and other firm characteristics. The return on assets is alternately regressed on the

quintiles of the four centrality measures and subsequently on the N-score incorporating these centrality measures.

We first check the R^2. This statistic indicates to what extent the variance in the spread is explained by the variance in the independent explanatory variables. In this model R^2 has a value of 0.21 for all five regressions. This is rather low, as only 21% of the variance is explained. Nevertheless, the F-statistic is significant on the 0.01 significance level, meaning that the explanatory power of the model is significant for all five regressions.

Furthermore, three firm characteristics, excluding the centrality measures, appear to be significantly different from zero. The logarithm of the book to market ratio, the leverage, and the logarithm of the assets of the firm all have a significant effect on the return on assets, at least on the 0.10 significance level.

Finally, the null hypothesis is tested. According to results of the regression, all five centrality measures appear to be insignificant. This insignificant effect is negative for the Quintiles of the Degree Centrality, the Closeness Centrality, and the Eigenvector Centrality, and the N-score, while the effect is positive for the Betweenness Centrality. Unfortunately, this is rather unimportant, as se affects are not significantly different from zero.

We conclude that the null hypothesis cannot be rejected on the 0.10 level of significance. This means that no significant effect of board centrality on the return on assets was found for this particular dataset of Belgian boards of directors. Obviously, there is no need for a robustness test by dividing the sample in subsamples and testing the hypothesis further on them, as the assumption does not hold for the totality of the sample.

Table 18: Regression results for Return on Assets

Regression for Return-on-Assets					
	(1)	(2)	(3)	(4)	(5)
Quintile(Degree Centrality)	-0.0016	-	-	-	-
	(-0.17)				
Quintile(Closeness Centrality)	-	-0.0038	-	-	-
		(-0.407)			
Quintile(Betweenness Centrality)	-	-	0.0012	-	-
			(-1.846)		
Quintile(Eigenvector Centrality)	-	-	-	-0.0016	-
				(-0.17)	
N-Score	-	-	-	-	-0.0029
					(-0.31)
LBM	-0.36*	-0.36*	-0.37*	-0.36*	-0.36*
	(-1.82)	(-1.809)	(-1.84)	(-1.82)	(-1.80)
Size	-0.037	-0.037	-0.039	-0.037	-0.036
	(-0.77)	(-0.72)	(-0.76)	(-0.73)	(-0.70)
Leverage	-0.27***	-0.27***	-0.27***	-0.27***	-0.27***
	(-6.68)	(-6.70)	(-6.66)	(-6.68)	(-6.66)
Assets	0.086*	0.087*	0.086*	0.086*	0.086*
	(1.74)	(1.75)	(1.75)	(1.74)	(1.74)
Intercept	-0.19	-0.19	-0.18	-0.19	-0.19
	(-1.38)	(-1.42)	(-1.31)	(-1.38)	(-1.40)
R-Squared	0.21	0.21	0.21	0.21	0.21
F-Statistic	12.83	12.87	12.83	12.83	12.85
p-value (F-Statistic)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
#Observations	245	245	245	245	245

Notes: Significances at the 0.01 (***), 0.05(**), and 0.10(*) level are denoted by the asterisks. The T-statistics are given in parantheses. LBM is defined as the logarithm of the sum of 1 with the book-to market value of the company. Size is the logarithm of the market value of the company. Leverage is the Total amount of liabilities divided by the book value of assets. Assets is defined as the logarithm of the book value of assets. All values are calculated at the end of the accounting year.

The second group of regressions is performed using the ordinary least squares method, as was the case in the previous example. Table 19 provides the results of the regression of the firms'

Tobin's Q on their network centralities and other firm characteristics. The Tobin's Q is alternately regressed on the quintiles of the four centrality measures and subsequently on the N-score incorporating these centrality measures.

As in previous example, we first check the R^2. In this model R^2 has a value of 0.69 for all five regressions. This is much larger than for the previous with a value of 69% of the variance is explained. Furthermore, the F-statistic is significant on the 0.01 significance level, meaning that the explanatory power of the model is significant for all five regressions.

All four firm characteristics, excluding the centrality measures, and the intercept appear to be significantly different from zero on the 0.01 level of significance. The logarithm of the book to market ratio, the logarithm of the market value of assets, the leverage, and the logarithm of the assets of the firm all have a significant effect on the Tobin's Q.

Finally, the null hypothesis is tested. According to results of the regression, all five centrality measures appear to be insignificant. This insignificant effect on the Tobin's Q is positive for all five centrality measures of the board. Unfortunately, this is rather unimportant, as the effects are not significantly different from zero.

The same conclusion as for the return on assets applies, as we conclude that the null hypothesis cannot be rejected on the 0.10 level of significance. This means that no significant effect of board centrality on the Tobin's Q was found for this particular dataset of Belgian boards of directors. Again, there is no need for a robustness test by dividing the sample in subsamples and testing the hypothesis further on them, as the assumption does not hold for the totality of the sample.

Table 19: Regression results for Tobin's Q

Regression for Tobin's Q					
	(1)	(2)	(3)	(4)	(5)
Quintile(Degree Centrality)	0.0061	-	-	-	-
	(0.23)				
Quintile(Closeness Centrality)	-	0.023	-	-	-
		(0.84)			
Quintile(Betweenness Centrality)	-	-	0.0049	-	-
			(0.21)		
Quintile(Eigenvector Centrality)	-	-	-	0.019	-
				(0.69)	
N-Score	-	-	-	-	0.021
					(0.802)
LBM	-2.60***	-2.62***	-2.60***	-2.61***	-2.63***
	(-4.39)	(-4.44)	(-4.37)	(-4.43)	(-4.45)
Size	1.42***	1.42***	1.42***	1.42***	1.41***
	(9.40)	(9.40)	(9.34)	(9.42)	(9.32)
Leverage	0.93***	0.93***	0.93***	0.93***	0.92***
	(7.75)	(7.76)	(7.65)	(7.77)	(7.68)
Assets	-1.45***	-1.45***	-1.45***	-1.45***	-1.45***
	(-10.02)	(-10.05)	(-9.98)	(-10.05)	(-10.02)
Intercept	2.15***	2.19***	2.15***	2.18***	2.20***
	(5.30)	(5.42)	(5.27)	(5.39)	(5.40)
R-Squared	0.69	0.69	0.69	0.69	0.69
F-Statistic	108.81	109.25	108.808	109.09	109.2
p-value (F-Statistic)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
#Observations	245	245	245	245	245

Notes: Significances at the 0.01 (***), 0.05(**), and 0.10(*) level are denoted by the asterisks. The T-statistics are given in parantheses. LBM is defined as the logarithm of the sum of 1 with the book-to market value of the company. Size is the logarithm of the market value of the company. Leverage is the Total amount of liabilities divided by the book value of assets. Assets is defined as the logarithm of the book value of assets. All values are calculated at the end of the accounting year.

	Quint (Degree Centrality)	Quint (Closeness Centrality)	Quint (Betweenness Centrality)	Quint (Eigenvector Centrality)	Tobin's Q	Return On Assets
Quint(Degree Centrality)	1					
Quint(Closeness Centrality)	0.921	1				
Quint(Betweenness Centrality)	0.861	0.814	1			
Quint(Eigenvector Centrality)	0.933	0.9505	0.7807	1		
ΔTobin's Q	0.141	0.212	0.158	0.1702	1	
ΔReturn On Assets	0.041	0.0535	0.0811	0.0478	0.148	1

Next, we do not examine the effects on the profitability of the firm anymore, but we investigate if the centrality has an effect on the changes in profitability. The first measure to be tested is the one-year-ahead change in return on assets. This measure is computed by subtracting the current return on assets from the one-year-ahead return on assets, i.e. 2011 and 2012, respectively Subtracting off the contemporaneous change in industry median return on assets, as is the case in Larcker, So, & Wang (2013), is not needed since only one dataset is observed.

Again, the regressions are performed using the ordinary least squares method, as was the case in the previous example. Table 20 provides the results of the regression of the firms' one-year – ahead change in return on assets on their network centralities and other firm characteristics.

As in previous examples, we first check the R^2. In this model R^2 has a value of 0.13 for all five regressions. This is even lower than in the first set of regressions. Additionally, the F-statistic is significant on the 0.01 significance level, meaning that the explanatory power of the model is significant for all five regressions.

Furthermore, three firm characteristics, excluding the centrality measures, appear to be significantly different from zero. The logarithm of the book to market ratio, the leverage, and the logarithm of the assets of the firm all have a significant effect on the change in return on assets, at least on the 0.10 significance level.

Finally, the null hypothesis is tested. According to results of the regression, all five centrality measures appear to be insignificant. This insignificant effect on the one-year-ahead change in return on assets is positive for all five centrality measures of the board. Unfortunately, this is rather unimportant, as the effects are not significantly different from zero.

The same conclusion as for the return on assets applies, as we conclude that the null hypothesis cannot be rejected on the 0.10 level of significance. This means that no significant effect of board centrality on the one-year-ahead change in return on assets was found for this particular dataset of Belgian boards of directors. Again, there is no need for a robustness test by dividing the sample in subsamples and testing the hypothesis further on them, as the assumption does not hold for the totality of the sample.

Table 20: Regression results for One-Year-Ahead Change in Return on Assets

Regression for One-Year-Ahead Change in Return-on-Assets					
	(1)	(2)	(3)	(4)	(5)
Quintile(Degree Centrality)	0.93	-	-	-	-
	(0.54)				
Quintile(Closeness Centrality)	-	0.65	-	-	-
		(0.38)			
Quintile(Betweenness Centrality)	-	-	0.73	-	-
			(0.50)		
Quintile(Eigenvector Centrality)	-	-	-	0.22	-
				(0.12)	
N-Score	-	-	-	-	0.93
					(0.54)
LBM	-64.36	-62.44	-63.94	-61.01	-64.36
	(-1.36)	(-1.33)	(-1.35)	(-1.29)	(-1.36)
Size	-23.46*	-22.92	-23.41*	-22.71	-23.63*
	(-1.68)	(-1.65)	(-1.68)	(-1.63)	(-1.69)
Leverage	-42.51***	-41.83***	-42.95***	-42.54***	-42.48***
	(-2.82)	(-2.79)	(-2.82)	(-2.78)	(-2.82)
Assets	29.52**	29.20**	29.64**	29.25**	29.68**
	(2.16)	(2.13)	(2.16)	(2.13)	(2.17)
Intercept	-24.93	-26.71	-25.31	-28.11	-24.88
	(-0.88)	(-0.95)	(-0.89)	(-0.99)	(-0.87)
R-Squared	0.13	0.13	0.13	0.13	0.13
F-Statistic	3.407	3.37	3.39	3.34	3.406
p-value (F-Statistic)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
#Observations	115	115	115	115	115

Notes: Significances at the 0.01 (***), 0.05(**), and 0.10(*) level are denoted by the asterisks. The T-statistics are given in parantheses. LBM is defined as the logarithm of the sum of 1 with the book-to market value of the company. Size is the logarithm of the market value of the company. Leverage is the Total amount of liabilities divided by the book value of assets. Assets is defined as the logarithm of the book value of assets. All values are calculated at the end of the accounting year.

The last step of the analysis continues the investigation on the changes in firm profitability. This time the one-year-ahead change in Tobin's Q is regressed instead of the one-year-ahead change in return on assets.

Again, the regressions are performed using the ordinary least squares method, as was the case in the previous example. Table 21 provides the results of the regression of the firms' one-year – ahead change in Tobin's Q on their network centralities and other firm characteristics.

As in previous examples, we first check the R^2. In this model R^2 has a value of 0.13 for all five regressions. This is even lower than in the first set of regressions. Additionally, the F-statistic is significant on the 0.01 significance level, meaning that the explanatory power of the model is significant for all five regressions.

Furthermore, two firm characteristics, excluding the centrality measures, appear to be significantly different from zero. The leverage and the logarithm of the assets of the firm all have a significant effect on the change in return on assets, at least on the 0.05 significance level.

Finally, the null hypothesis is tested. According to results of the regression, all five centrality measures appear to be insignificant. This insignificant effect on the one-year-ahead change in Tobin's Q is negative for all five centrality measures of the board.

The same conclusion as for the return on assets applies, as we conclude that the null hypothesis cannot be rejected on the 0.10 level of significance. This means that no significant effect of board centrality on the one-year-ahead change in Tobin's Q was found for this particular dataset of Belgian boards of directors. Again, there is no need for a robustness test by dividing the sample in subsamples and testing the hypothesis further on them, as the assumption does not hold for the totality of the sample.

Table 21: Regression results for One-Year-Ahead change in Tobin's Q

Regression for One-Year-Ahead Change in Tobin's Q					
	(1)	(2)	(3)	(4)	(5)
Quintile(Degree Centrality)	-16.75	-	-	-	-
	(-0.53)				
Quintile(Closeness Centrality)	-	-11.71	-	-	-
		(-0.37)			
Quintile(Betweenness Centrality)	-	-	-13.22	-	-
			(-0.49)		
Quintile(Eigenvector Centrality)	-	-	-	-3.67	-
				(-0.11)	
N-Score	-	-	-	-	-16.73
					(-0.52)
LBM	1144.42	1109.302	1136.73	1083.12	1143.89
	(1.32)	(1.28)	(1.31)	(1.25)	(1.32)
Size	421.36	411.63	420.507	407.801	424.303
	(1.65)	(1.61)	(1.64)	(1.60)	(1.65)
Leverage	771.15***	758.80***	779.01***	753.47***	770.47***
	(2.79)	(2.76)	(2.79)	(2.75)	(2.79)
Assets	-532.88**	-527.19**	-532.96**	-527.99**	-535.63**
	(-2.12)	(-2.10)	(-2.13)	(-2.10)	(2.13)
Intercept	471.25	503.84	478.26	529.62	470.75
	(0.90)	(0.98)	(0.92)	(1.01)	(0.90)
R-Squared	0.13	0.13	0.13	0.13	0.13
F-Statistic	3.38	3.35	3.37	3.32	3.38
p-value (F-Statistic)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
#Observations	115	115	115	115	115

Notes: Significances at the 0.01 (***), 0.05(**), and 0.10(*) level are denoted by the asterisks. The T-statistics are given in parantheses. LBM is defined as the logarithm of the sum of 1 with the book-to market value of the company. Size is the logarithm of the market value of the company. Leverage is the Total amount of liabilities divided by the book value of assets. Assets is defined as the logarithm of the book value of assets. All values are calculated at the end of the accounting year.

7 Conclusion

The aim of this research is to analyse the ties between the Belgian companies listed on Euronext Brussels and investigate the influence of their well-connectedness on the firm performance. The networks formed by Belgian boards were analysed at two different times, once for 2011, and once for 2016. In the first part of the research, the general characteristics of the boards composing these networks were illustrated. This was followed by an application of the principles of Social Network Analysis to compute centrality measures for the networks, as well as the investigation for small world properties. Finally, the influence of the computed centrality measures on firm performance was investigated.

The investigation of the data resulted in two findings. The proportion of female directors on Belgian corporate boards drastically increased the last 5 years. This proportion increased from an average of approximately 8% to an average of approximately 21%. Additionally, the percentage of boards with no female members decreased from more than 54% in 2011 to a mere 20% in 2016. Nevertheless, a large progress still needs to be made, as only 22% of the boards meet the one third proportion of females set up by the legislation. The data also indicates that the problematic of overcommitted directors is quasi inexistent in Belgian. Only 2.2% of the Belgian directors had more than 2 shared directorships in 2016. In addition to this, no overcommitted boards are found for both 2011 and 2016. These are boards with more than 50% of overcommitted directors. These statistics are much lower than in Germany, were more than 46% of companies had overcommitted boards in the period 2003-2006.

For the further part of the network analysis, the data was divided in two distinct networks, a network of boards and a network of directors. This had as purpose to identify the centralities of both the companies and the directors that belong to them. A benchmark of the most central companies and directors was created. A usual characteristic for social networks was observed: a select group of directors hold the shared directorships, and therefore the highest centralities, while the overall majority of directors do not have directorships on other companies, and therefore have a much lower centrality.

To make the regression analysis possible, four types of centralities, each representing a different measure of importance inside the network, were computed. A fifth measure incorporates the four centralities to provide a measure of overall well-connectedness. These measures were

computes for the two types of networks on the two observed times. An anomaly occurred when calculating the Eigenvector Centrality for the networks of directors. The directors being member of large boards had their Eigenvector Centrality being much larger than on boards with a smaller amount of directors. A solution was proposed to remediate the anomaly, but as measure of security, only the centrality measures of the networks of boards were used for the following regression analysis.

The final analysis of the characteristics of the networks investigated for small world properties. The characteristics that were found are typical for networks exhibiting the small world phenomenon: The network density is low and there is a high tendency to form clusters. The Watts-Strogatz statistics definitely concluded that the networks exhibit small world properties. This means that the speed of information transfer is higher than in randomized networks.

Finally, the network measures found in the analysis of the network were regressed on indicators of firm performance. The dependent variables employed are the return on assets and the Tobin's Q, while the network measures are the Degree Centrality, the Closeness Centrality, the Betweenness Centrality, the Eigenvector Centrality, and the N-score. Additionally the network measures were also regressed on the yearly change in firm performance.

No significant influence of these centrality measures on firm performance could be found. We conclude that the well-connectedness of a board does not influence the performance of its company, nor is there does it influence the change in firm performance.

These findings contradict other results found in the academic literature. The possible reasons could be that the results from the literature happen to correlate with indicators of firm performance for those particular cases. Other reasons could be that the network of Belgian boards differs too much from the boards of other countries in both composition and scale, indeed differences were found in the characteristics, like the network density or larger average shortest path length. These differences could influence the outcome of the regression. Finally, it could be that an association exists, but that the specification is incorrect.

7.1 Limitations and outlook

A number of limitations exist for this research. We analysed a specific time series and are therefore only looking at past cases. This does not give us any guarantee that the model developed in this research is applicable for future cases. Additionally, only two moments in time where analysed, while other researchers investigate much larger timespans and much larger datasets. Gathering such an amount of information was clearly not possible for a Master's

Thesis. Moreover, companies are such complex entities that it is rather difficult to find correct indicators of firm performance.

The networks of boards are not static, but will evolve over time. This means that there will always be possibilities for future research to analyse those future networks. Additionally, larger datasets over longer time periods could be investigated in the future, that could provide different conclusions. The ties that connect companies could also be examined differently; there are a lot of different ways companies are tied to each other. Finally, the way directors are connected to one another could also be inspected in another ways. People do not know each other and communicate exclusively through shared board memberships, but can know each other through their social or professional circles. This analysis would be much more difficult to perform; but can give an indication for future research.

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9 Appendices

Appendix 1 Source Code

The code to compute the different edge matrices needed for GEPHI and NETMINER was written in the Java programming language and compiled NetBeans 8. The input for the program is a CSV file made out of a list of the different directors and the board they are part of. The program provides an output with a list of numbered edges that represent the links between the different directors.

```
package edgegenerator;

import java.io.BufferedReader;
import java.io.File;
import java.io.FileNotFoundException;
import java.io.FileReader;
import java.io.FileWriter;
import java.io.IOException;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;
import java.util.Scanner;

public class EdgeGenerator {
    public static void main(String[] args) throws IOException {

        String fileName= "list.csv";
          BufferedReader reader = new BufferedReader(new FileReader(
                                                fileName));
```

```
                // read file line by line
                String line = null;
                Scanner scanner = null;
                int index = 0;
                int lineNo = 0;
String[] ids = new String[1299];
      String[] namen = new String[1299];
      String[] bedrijf = new String[1299];
      String[] weights = new String[1299];

                while ((line = reader.readLine()) != null) {

                        scanner = new Scanner(line);
                        scanner.useDelimiter(",");
                        while (scanner.hasNext()) {
                                String data = scanner.next();
                    System.out.println(data);
                                if (index == 0)
                                        ids[lineNo] = data;
                                else if (index == 1)
                                        namen[lineNo] = data;
                                else if (index == 2)
                                        bedrijf[lineNo] = data;
                    index++;
                        }
                        index = 0;
                        lineNo++;
                }

      for(int j=0; j< namen.length; j++)
       {
```

```
for( int k = j+1; k< bedrijf.length; k++)
    {
        if(namen[k].equalsIgnoreCase(namen[j]))
                {
                ids[k] = ids[j];
                }
    }
double tussenweight = countdirectors(j,bedrijf) -1;
double weight = 1/tussenweight;
System.out.println(weight);
String weight2 = String.valueOf(weight);
weights[j] = weight2;
}
 String csvFile = "edges.csv";
FileWriter writer = new FileWriter(csvFile);
       FileWriter writer2 = new FileWriter(csvFile2);
for(int j=0; j< namen.length; j++)
{
    boolean goed = true;
    List<String> list2 = new ArrayList<>();

    for(int m =0; m< j; m++)
    {
       if(namen[m].equalsIgnoreCase(namen[j]))
       {
         goed = false;
       }
    }

    if(goed)
    {
```

```
            list2.add(ids[j]);
                    list2.add(namen[j]);
            list2.add(bedrijf[j]);
            CSVUtils.writeLine(writer2, list2);
            }
            for( int k = j+1; k< bedrijf.length; k++)
            {
               if(bedrijf[k].equalsIgnoreCase(bedrijf[j]))
               {
                  List<String> list = new ArrayList<>();
                  list.add(ids[j]);
                  list.add(ids[k]);
                  list.add(weights[j]);
                CSVUtils.writeLine(writer, list);
               }
            }
        writer.flush();
        writer.close();
writer2.flush();
        writer2.close();
    }}

    public static double countdirectors(int i,String[] bedrijf)
    {
        double aantal = 0;
        for( int k = 0; k< bedrijf.length; k++)
            {
                if(bedrijf[k].equalsIgnoreCase(bedrijf[i]))
                            {
                             aantal++;
                            }
```

```
}
        System.out.println(aantal);
        return aantal;
    }
}
```

Appendix 2.1 List of companies (2011)

This list provides an overview of the companies selected to perform the research.

Table 22: List of Companies for 2011

	Company Name	*Industry*	*ISIN Code*
1	4ENERGY INVEST	Utilities	BE0003888089
2	AB INBEV	Consumer Staples	BE0003793107
3	ABLYNX	Healthcare	BE0003877942
4	ACCENTIS	Industrials	BE0003696102
5	ACKERMANS & VAN HAAREN	Financials	BE0003764785
6	AEDIFICA	Financials	BE0003851681
7	AGEAS	Financials	BE0003801181
8	AGFA GEVAERT	Industrials	BE0003755692
9	ALFACAM GROUP	Consumer Discretionary	BE0003868859
10	ARCELORMITTAL	Basic Materials	LU0323134006
11	ARSEUS	Healthcare	BE0003874915
12	ARTHUR	Consumer Discretionary	FR0004166155
13	ASCENCIO	Financials	BE0003856730
14	ATENOR GROUP	Financials	BE0003837540
15	BANIMMO	Financials	BE0003870871
16	BARCO	Industrials	BE0003790079
17	BEFIMMO	Financials	BE0003678894
18	BEKAERT	Industrials	BE0974258874
19	BELGACOM	Telecom Services	BE0003810273
20	BELRECA	Financials	BE0020575115
21	BELUGA	Financials	BE0003723377
22	BANQUE NAT BELGE	Financials	BE0003008019
23	BREDERODE	Financials	BE0003792091
24	CAMPINE	Basic Materials	BE0003825420
25	CFE	Industrials	BE0003883031
26	CIE BOIS SAUVAGE	Financials	BE0003592038
27	CIMESCAUT	Industrials	BE0003304061
28	CMB	Industrials	BE0003817344
29	COFINIMMO	Financials	BE0003593044
30	COLRUYT	Consumer Discretionary	BE0974256852
31	CONNECT GROUP	Industrials	BE0003786036
32	D'IETEREN	Consumer Discretionary	BE0974259880

33	DECEUNINCK	Industrials	BE0003789063
34	DEFICOM GROUP	Consumer Discretionary	BE0003624351
35	DELHAIZE GROUP	Consumer Discretionary	BE0003562700
36	DEVGEN	Healthcare	BE0003821387
37	DEXIA	Financials	BE0003796134
38	DUVEL MOORTGAT	Consumer Staples	BE0003762763
39	ECONOCOM GROUP	Information Technology	BE0003563716
40	ELIA	Utilities	BE0003822393
41	EURONAV	Industrials	BE0003816338
42	EVS	Information Technology	BE0003820371
43	EXMAR	Industrials	BE0003808251
44	FLORIDIENNE	Industrials	BE0003215143
45	FLUXYS	Utilities	BE0003803203
46	FOUNTAIN	Consumer Staples	BE0003752665
47	GALAPAGOS	Healthcare	BE0003818359
48	GBL	Financials	BE0003797140
49	GDF SUEZ	Utilities	FR0010208488
50	GIMV	Financials	BE0003699130
51	GLOBAL GRAPHICS	Information Technology	FR0004152221
52	HAMON	Industrials	BE0003700144
53	HENEX	Consumer Staples	BE0003873909
54	HOME INVBELG SIFI	Financials	BE0003760742
55	IRIS GROUP	Information Technology	BE0003756708
56	IBA	Healthcare	BE0003766806
57	IBT	Healthcare	BE0003689032
58	IMMO MOURY	Financials	BE0003893139
59	IMMOBEL	Financials	BE0003599108
60	ING GROEP	Financials	NL0000303600
61	INTERVRETAIL	Financials	BE0003754687
62	INTERVEST OFFICES	Financials	BE0003746600
63	JENSEN GROUP	Industrials	BE0003858751
64	KBC	Financials	BE0003565737
65	KBC ANCORA	Financials	BE0003867844
66	KEYWARE TECH	Information Technology	BE0003880979
67	KINEPOLIS GROUP	Consumer Discretionary	BE0003722361
68	LEASINVEST	Financials	BE0003770840
69	LOTUS BAKERIES	Consumer Staples	BE0003604155
70	MDXHEALTH	Healthcare	BE0003844611
71	MEDIVISION	Healthcare	IL0010846314
72	MELEXIS	Information Technology	BE0165385973
73	MIKO	Consumer Staples	BE0003731453

74	MOBISTAR	Telecom Services	BE0003735496
75	MONTEA	Financials	BE0003853703
76	MOPOLI	Financials	NL0000488153
77	MOURY CONSTRUCT	Industrials	BE0003602134
78	NAT PORTEFEUIL	Financials	BE0003845626
79	NEUFCOUR FIN	Financials	BE0003680916
80	NYRSTAR	Basic Materials	BE0003876936
81	OIM	Financials	GB00B063YS85
82	OMEGA PHARMA	Healthcare	BE0003785020
83	OPTION	Information Technology	BE0003836534
84	PARC PARADISIO	Consumer Discretionary	BE0003771855
85	PAYTON PLANAR	Industrials	IL0010830391
86	PCB	Consumer Discretionary	BE0003503118
87	PICANOL	Industrials	BE0003807246
88	PINGUINLUTOSA	Consumer Staples	BE0003765790
89	PUNCH INT	Industrials	BE0003748622
90	QUESTFOR GR	Financials	BE0003730448
91	REALDOLM	Information Technology	BE0003899193
92	RECTICEL	Basic Materials	BE0003656676
93	RENTABILIWEB	Information Technology	BE0946620946
94	RESILUX	Industrials	BE0003707214
95	RETAIL EST	Financials	BE0003720340
96	RHJ INTERNATIONAL	Financials	BE0003815322
97	ROSIER	Basic Materials	BE0003575835
98	ROULARTA	Consumer Discretionary	BE0003741551
99	RTL GROUP	Consumer Discretionary	LU0061462528
100	SABCA	Industrials	BE0003654655
101	SAINT GOBAIN	Industrials	FR0000125007
102	SAPEC	Consumer Staples	BE0003625366
103	SVK	Industrials	BE0012378593
104	SERVICEFLATS	Financials	BE0003677888
105	SIOEN	Consumer Staples	BE0003743573
106	SIPEF	Consumer Staples	BE0003898187
107	SOFINA	Financials	BE0003717312
108	SOLVAC	Basic Materials	BE0003545531
109	SOLVAY	Basic Materials	BE0003470755
110	SPADEL	Consumer Staples	BE0003798155
111	SPECTOR	Consumer Staples	BE0003663748
112	SUCRAF	Consumer Staples	BE0003463685
113	SUEZ	Utilities	FR0010613471
114	SYSTEMAT	Information Technology	BE0003773877

115	TELENET	Telecom Services	BE0003826436
116	TER BEKE	Consumer Staples	BE0003573814
117	TESSENDERLO	Basic Materials	BE0003555639
118	TEXAF	Financials	BE0003550580
119	THENERGO	Utilities	BE0003895159
120	THINK MEDIA	Consumer Discretionary	BE0003804219
121	THROMBOGENICS	Healthcare	BE0003846632
122	TIGENIX	Healthcare	BE0003864817
123	TOTAL	Utilities	FR0000120271
124	TRANSICS	Information Technology	BE0003869865
125	TUBIZE FIN	Financials	BE0003823409
126	UCB	Healthcare	BE0003739530
127	UMICORE	Basic Materials	BE0003884047
128	UNIBRA	Industrials	BE0003064574
129	VAN DE VELDE	Consumer Staples	BE0003839561
130	VGP	Financials	BE0003878957
131	VPK PACKAGING	Industrials	BE0003749638
132	VRANKEN POMMERY	Consumer Staples	FR0000062796
133	WAREHOUSES SICAFI	Financials	BE0003734481
134	WAREHOUSES DEPAUW	Financials	BE0003763779
135	WERELDHAVE	Financials	BE0003724383
136	ZENITEL	Information Technology	BE0003806230
137	ZETES INDUSTRIES	Industrials	BE0003827442

Appendix 2.2 List of companies (2016)

Table 23: List of companies for 2016

	Company Name	*Industry*	*ISIN Code*
1	4ENERGY INVEST	Utilities	BE0003888089
2	AB INBEV	Consumer Staples	BE0003793107
3	ABLYNX	Healthcare	BE0003877942
4	ABO GROUP	Industrials	BE0974278104
5	ACCENTIS	Financials	BE0003696102
6	ACKERMANS & VAN HAAREN	Financials	BE0003764785
7	AEDIFICA	Financials	BE0003851681
8	AGEAS	Financials	BE0003801181
9	AGFA-GEVAERT	Industrials	BE0003755692
10	AHOLD DELHAIZE	Consumer Discretionary	NL0011794037
11	APERAM	Materials	LU0569974404
12	ARGENX	Healthcare	NL0010832176
13	ASCENCIO	Financials	BE0003856730
14	ASIT	Healthcare	BE0974289218
15	ATENOR	Financials	BE0003837540
16	AVANTIUM	Industrials	NL0012047823
17	BANIMMO	Financials	BE0003870871
18	BANQUE NAT BELGE	Financials	BE0003008019
19	BARCO	Industrials	BE0003790079
20	BEFIMMO	Financials	BE0003678894
21	BEKAERT	Industrials	BE0974258874
22	BELRECA	Financials	BE0020575115
23	BELUGA	Financials	BE0003723377
24	BIOCARTIS	Healthcare	BE0974281132
25	BONE THERAPEUTICS	Healthcare	BE0974280126
26	BPOST	Financials	BE0974268972
27	BREDERODE	Financials	BE0003792091
28	CAMPINE	Materials	BE0003825420
29	CARE PROPERTY INVEST	Financials	BE0974273055
30	CELYAD	Healthcare	BE0974260896
31	CENERGY	Utilities	BE0974303357
32	CFE	Industrials	BE0003883031
33	CIE BOIS SAUVAGE	Financials	BE0003592038
34	COFINIMMO	Financials	BE0003593044
35	COLRUYT	Consumer Discretionary	BE0974256852
36	CONNECT GROUP	Industrials	BE0003786036
37	CURETIS	Healthcare	NL0011509294
38	D'IETEREN	Consumer Discretionary	BE0974259880

39	DALENYS	Information Technology	BE0946620946
40	DECEUNINCK	Industrials	BE0003789063
41	DELTA LLOYD	Financials	NL0009294552
42	DEXIA	Financials	BE0003796134
43	ECKERT ZIEGLER	Healthcare	BE0003689032
44	ECONOCOM	Information Technology	BE0003563716
45	ELIA	Utilities	BE0003822393
46	EMAKINA	Information Technology	BE0003843605
47	ENGIE	Utilities	FR0013055100
48	ENVIPCO	Industrials	NL0009901610
49	EURONAV	Industrials	BE0003816338
50	EURONEXT	Financials	FR0000060170
51	EVS	Information Technology	BE0003820371
52	EXMAR	Industrials	BE0003808251
53	FAGRON	Healthcare	BE0003874915
54	FLORIDIENNE	Financials	BE0003215143
55	FLUXYS	Utilities	BE0003803203
56	FNG	Financials	NL0012047849
57	FOUNTAIN	Consumer Staples	BE0003752665
58	GALAPAGOS	Healthcare	BE0003818359
59	GBL	Financials	BE0003797140
60	GENKYOTEX	Healthcare	FR00011790542
61	GIMV	Financials	BE0003699130
62	GLOBAL GRAPHICS	Information Technology	FR0004152221
63	GREENYARD	Consumer Staples	BE0003765790
64	HAMON	Industrials	BE0003700144
65	HOME INVEST	Financials	BE0003760742
66	IBA	Healthcare	BE0003766806
67	IEP INVEST	Financials	BE0003748622
68	IMMO BEAULIEU	Financials	BE0003661726
69	IMMO LUX AIRPORT	Financials	LU0092846210
70	IMMO MOURY	Financials	BE0003893139
71	IMMOBEL	Financials	BE0003599108
72	ING	Financials	NL0000303600
73	INTERVEST	Financials	BE0003746600
74	JENSEN GROUP	Industrials	BE0003858751
75	KBC	Financials	BE0003565737
76	KBC ANCORA	Financials	BE0003867844
77	KEYWARE	Information Technology	BE0003880979
78	KIADIS	Healthcare	NL0011323407
79	KINEPOLIS	Consumer Discretionary	BE0003722361
80	KKO INTERNATIONAL	Industrials	BE0974284169
81	LEASINVEST	Financials	BE0003770840
82	LOTUS BAKERIES	Consumer Staples	BE0003604155

83	MDXHEALTH	Healthcare	BE0003844611
84	MELEXIS	Information Technology	BE0165385973
85	MIKO	Consumer Staples	BE0003731453
86	MITHRA	Healthcare	BE0974283153
87	MONTEA	Financials	BE0003853703
88	MOURY CONSTRUCT	Industrials	BE0003602134
89	NYRSTAR	Basic Materials	BE0003876936
90	OIM	Financials	GB00B063YS85
91	ONTEX	Consumer Staples	BE0974276082
92	OPTION	Financials	BE0003836534
93	OPTION TRADING CO	Financials	BE0003834513
94	ORANGE BE	Telecom Services	BE0003735496
95	PCB	Consumer Discretionary	BE0003503118
96	PICANOL	Industrials	BE0003807246
97	PROXIMUS	Telecom Services	BE0003810273
98	QRF	Financials	BE0974272040
99	QUEST for GROWTH	Financials	BE0003730448
100	REALDOLMEN	Information Technology	BE0003899193
101	RECTICEL	Basic Materials	BE0003656676
102	RESILUX	Industrials	BE0003707214
103	RETAIL EST	Financials	BE0003720340
104	ROSIER	Basic Materials	BE0003575835
105	ROULARTA	Consumer Discretionary	BE0003741551
106	RTL GROUP	Consumer Discretionary	LU0061462528
107	SABCA	Industrials	BE0003654655
108	SAINT GOBAIN	Industrials	FR0000125007
109	SAPEC	Consumer Staples	BE0003625366
110	SKV	Industrials	BE0012378593
111	SIOEN	Consumer Staples	BE0003743573
112	SIPEF	Consumer Staples	BE0003898187
113	SMARTPHOTO GROUP	Information Technology	BE0003663748
114	SSPDE	Financials	BE0405844436
115	SCB	Consumer Staples	BE0003519270
116	SOFINA	Financials	BE0003717312
117	SOLVAC	Basic Materials	BE0003545531
118	SOLVAY	Basic Materials	BE0003470755
119	SPADEL	Consumer Staples	BE0003798155
120	SUCRAF	Consumer Staples	BE0003463685
121	SUEZ	Utilities	FR0010613471
122	TELENET	Telecom Services	BE0003826436
123	TER BEKE	Consumer Staples	BE0003573814
124	TESSENDERLO	Basic Materials	BE0003555639
125	TEXAF	Financials	BE0003550580
126	THROMBOGENICS	Healthcare	BE0003846632

127	TIGENIX	Healthcare	BE0003864817
128	TINC INVEST	Financials	BE0974282148
129	TOTAL	Utilities	FR0000120271
130	TUBIZE FIN	Financials	BE0003823409
131	UCB	Healthcare	BE0003739530
132	UMICORE	Basic Materials	BE0003884047
133	VAN DE VELDE	Consumer Staples	BE0003839561
134	VASTNED BE	Financials	BE0003754687
135	VGP	Financials	BE0003878957
136	VIOHALCO	Industrials	BE0003878957
137	WAREHOUSES DE PAUW	Financials	BE0003763779
138	WAREHOUSES ESTATES	Financials	BE0003734481
139	WERELDHAVE BE	Financials	BE0003724383
140	XIOR	Financials	BE0974288202
141	ZENITEL	Information Technology	BE0003806230
142	ZETES IND	Industrials	BE0003827442

Appendix 3.1 List of directors (2011)

Table 24: List of directors per company (2011)

	Company Name	*Name of the Board Members*
1	4ENERGY INVEST	Nico Terry, Guido Schockaert, Daniel Deroux, Filip Lesaffer, Henry Meyers, Yves Crits
2	AB INBEV	Jean Luc Dehaene, Mark Winkelman, Kees Storm, Arnoud de Pret Roose de Carlsberg, Gregoire de Spoelberg, Alexandre Van Damme, Jorge Paulo Lemann, Carlos Alberto da Veiga Sicupira, Roberto Moses Thompson Motta, Mercel Herrmann Telles, Stefan Descheemaeker, August Busch IV, Peter Harf
3	ABLYNX	Edwin Moses, Stephen Bunting, Geert Cauwenbergh, Denis Lucquin, Mats Pettersson, Jim Van heusden, Remi Vermeiren,
4	ACCENTIS	Jacques de Bliek, Wim Deblauwe, Jean Luc Desmet, Hubert Ooghe, Wouter Vandeberg,
5	ACKERMANS & VAN HAAREN	Alain Dieryck, Luc Bertrand, Jacques Delen, Teun Jurgens, Pierre Macharis, Thierry van Baren, Frederic van Haaren, Pierre Willaert,
6	AEDIFICA	Jean Louis Duplat, Stefaan Gielens, Pierre Iserbyt, Adeline Simont, Brigitte Gouder de Beauregard, Jacques Blanpain, Sophie Maes,
7	AGEAS	Jozef De Mey, Guy de Selliers de Moranville, Bart De Smet, Frank Arts, Shaoliang Jin, Bridget McIntyre, Roel Nieuwdorp, Lionel Perl, Belen Romana, Jan Zegering Hadders,
8	AGFA GEVAERT	Julien De Wilde, Michel Akkermans, Jo Cornu, Willy Duron, Horst Heidsieck, Roland Junck, Christian Leysen, Christian Reinaudo, Wilfried Van Lishout,
9	ALFACAM GROUP	Hugo Vandamme, Gabriel Fehervari, Karin Stoop, Alain Keppens, Luc Van Milders, Erik Vanderhaegen,
10	ARCELORMITTAL	Lakshmi N Mittal, Vanisha Mittal Bhatia, Narayanan Vaghul, Wilbur L Ross Jr, Lewis B Kaden, Francois Pinault, Jeannot Krecke, Antoine Spillmann, Guillaume de Luxembourg,
11	ARSEUS	Robert Peek, Gerardus van Jeveren, Jan Peeters, Johannes Stols, Marc Coucke, Luc Vandewalle, Frank Vlayen, Cedric Van Cauwenberghe, Julien De Wilde,
12	ARTHUR	Jean Louis Pariente, Pierre Alain Pariente, Lionnel Rainfray
13	ASCENCIO	Carl Mestdagh, Fabienne D'Ans, Alain Devos, Benoit Godts, Jean Luc Calonger, Thomas Spitaels, Damien Fontaine, Yves Klein,
14	ATENOR GROUP	Frank Donck, Stephan Sonneville, Luc Bertrand, Charles Louis d'Arenberg, Marc De Pauw, Regnier Haegelsteen, Francois Tesch,

15	BANIMMO	Maryse Aulagnon, Cyril Aulagnon, Alain Chaussard, Didrik van Caloen, Christian Terlinden, Patrick Henniquau, Dominique de Ville de Goyet, Patrick Buffet, Jacques Etienne de T'Serclaes, Emmanuel van Innis,
16	BARCO	Herman Daems, Eric Van Zele, Bruno Holthof, Marc Ooms, Jan P Oosterveld, Marc Vercruysse, Christina von Wackerbarth, Luc Missorten, Urbain Vandeurzen, Walter Bracke,
17	BEFIMMO	Alain Devos, Benoit De Blieck, Benoit Godts, Jacques Rousseaux, Andre Sougne, Marc Van Heddeghem, Hugues Delpine, Etienne Dewulf,
18	BEKAERT	Paul Buysse, Bert De Graeve, Alan Begg, Leon Bekaert, Roger Dalle, Charles de Liedekerke, Francois de Visscher, Anthony Galsworthy, Hubert Jacobs van Merlen, Maxime Jadot, Barbara Thomas Judge, Bernard van de Walle de Ghelcke, Baudouin Velge, Manfred Wennemer,
19	BELGACOM	Theo Dilissen, Didier Bellens, Martine Durez, Michel Moll, Paul Van de Perre, Pierre Alain De Smedt, Carine Doutrelepont, George Jacobs, Oren G Shaffer, Lutgart Van den Berghe, Jo Cornu, Mimi Lamote, Guido JM Demuynck, Michele Sioen,
20	BELRECA	Michel Van de Put, Eric van de Put, Arnaud van de Put, Gaetan Gilles de Pelichy,
21	BELUGA	Dirk Geerinckx, Serge Stroïnovsky, Francois Vogeleer, Guido Wallebroek, Philippe L Weill, Bruno Lippens, Michel Balieus
22	BANQUE NAT BELGE	Luc Coene, Marcia De Wachter, Jan Smets, Francoise Masai, Jan Hilgers, Peter Praet, Norbert De Batselier,
23	BREDERODE	Pierre van der Mersch, Luigi Santambrogio, Axel van der Mersch, Gerard Cotton, Michel Delloye, Bruno Colmant, Alain Siaens,
24	CAMPINE	Richard P Pearson, Aime De Witte, Geert Krekel, Friedrich Wilhelm Hempel, Andre Hempel, Patrick De Groote, H Orgs,
25	CFE	Philippe Delaunois, Renaud Bentegeat, Alfred Bouckaert, Philippe Delusinne, Richard Francioli, Bernard Huvelin, Christian Labeyrie, Jean Rossi, Ciska Servais, Jan Steyaert,
26	CIE BOIS SAUVAGE	Guy Paquot, Christine Blondel, Jean Claude Daoust, Michel Delloye, Vincent Doumier, Pierre Yves de Lammine de Bex, Patrick Van Craen, Luc Vansteenkiste, Luc Willame,
27	CIMESCAUT	Olivier Bertrand, Paul Bertrand, Pierre Bertrand, Marie Claire Bertrand, Robert Cobbaut, Daniel Delmeire, Daniel Dufrasne, Danny Vannevel, Gustave Rappaz, Sylvie Brichard, Andre Jacquemart,
28	CMB	Marc Saverys, Benoit Timmermans, Ludwig Criel, Etienne Davignon, Thomas Leysen, Jean Peterbroeck, Nicolas Saverys, Virginie Saverys, Alexander Saverys, Eric Verbeeck,
29	COFINIMMO	Andre Dirckx, Andre Bergen, Jean Edouard Carbonnelle, Xavier de Walque, Vincent Doumier, Serge Fautre, Jean Franken, Robert Franssen, Gaetan Hannecart, Francoise Roels, Alain Schockert, Gilbert van Marcke de Lummen, Baudouin Velge,
30	COLRUYT	Frans Colruyt, Francois Gillet, Piet Colruyt, Willy Delvaux, Jef Colruyt
31	CONNECT GROUP	Erik Dejonghe, Huub Baren, Luc Switten, Guy van Dievoet, Freddy Daniels, Piet Serrure, Dominique Moorkens,

32	D'IETEREN	Roland D'Ieteren, Maurice Perier, Jean Pierre Bizet, Nicolas D'Ieteren, Pascal Minne, Olivier Perier, Alain Philippson, Gilbert van Marcke de Lummen, Christian Varin, Christine Blondel, Etienne Heilporn, Michel Alle, Axel Minne,
33	DECEUNINCK	Pierre Alain De Smedt, Arnold Deceuninck, Francois Gillet, Tom Debusschere, Willy Deceuninck, Sophie Malarme Lecloux, Clement De Meersman, Herwig Bamelis, Gerhard Rooze, Marcel Klepfisch,
34	DEFICOM GROUP	Jean Jacques De Cloedt, Philippe Lhomme, Anne Bataille, Vincent Bribosia, Bernard Marchant, Jean De Cloedt, Cecile Droz, Fabio Mazzoni, Eric Bauche, Denis Stokkink,
35	DELHAIZE GROUP	Graaf Jacobs de Hagen, Pierre Olivier Beckers, Claire Babrowski, Francois Cornelis, Arnoud de Pret Roose de Calesberg, Jacques de Vaucleroy, Hugh Farrington, Richard Goblet d'Alviella, Robert J Murray, Didier Smits, Jack Stahl, Luc Vansteenkiste,
36	DEVGEN	Remi Vermeiren, Thierry Bogaert, Orlando de Ponti, Jan Leemans, Rudi Marien, Patrick Van Beneden, Alan Williamson,
37	DEXIA	Jean Luc Dehaene, Pierre Mariani, Gilles Benoist, Isabelle Bouillot, Olivier Bourges, Brigitte Chanoine, Robert de Metz, Stefaan Decraene, Christian Giacomotto, Antointe Gosset Grainville, Catherine Kopp, Serge Kubla, Olivier Mareuse, Francine Swiggers, Bernard Thiry, Marc Tinant, Koen Van Loo, Francis Vermeiren,
38	DUVEL MOORTGAT	Michel Van Hemele, Veerle Baert, Michel Moortgat, Philippe Moortgat, Bernard Moortgat, Wilfried Vandepoel,
39	ECONOCOM GROUP	Jean Louis Bouchard, Jean Philippe Roesch, Bruno Lemaistre, Robert Bouchard, Christian Bret, Gaspard Durlleman, Rafi Kouyoumdjian, Charles de Water,
40	ELIA	Luc Van Nevel, Francis Vermeiren, Thierry Willemarck, Jennifer Debatisse, Clement de Meersman, Johan De Roo, Jacques de Smet, Claude Gregoire, Jean Marie Laurent Josi, Miriam Maes, Jane Murphy, Dominique Offergeld, Steve Stevaert, Leen Van den Neste, Ronnie Belmans,
41	EURONAV	Marc Saverys, Peter G Livanos, Patrick Rodgers, Ludwig Criel, Stephen Van Dyck, Daniel R Bradshaw, Patrick Molis, Nicolas G Kairis, Virginie Saverys,
42	EVS	Francis Bodson, Michel Counson, Jean Dumbruch, Jacques Galloy, Pierre L'Hoest, Laurent Minguet, Jean Pierre Pironnet, Christian Raskin, Pierre Rion,
43	EXMAR	Philippe Bodson, Nicolas Saverys, Ludwig Criel, Patrick De Brabandere, Philippe van Marcke de Lummen, Philippe Vlerick, Francois Gillet, Leo Cappoen, Pauline Saverys, Jens Ismar, Guy Verhofstadt,
44	FLORIDIENNE	Philippe Bodson, Marc Yves Blanpain, Bernard de Gerlache de Gomery, Philippe de Spoelberch, Loïc Waucquez, Gaetan Waucquez, Yves Meurice,
45	FLUXYS	Daniel Termont, Claude Gregoire, Jean Jacques Cayeman, Paul De fauw, Mireille Deziron, Luc Hujoel, Luc Janssens, Patrick Moenaert, Josly Piette, Christian Viaene, Luc Zabeau, Marianne Basecq, Sophie Brouhon, Caroline De Padt, Andre Farber, Monique Lievens, Walter Nonneman, Henriette Van Caenegem,
46	FOUNTAIN	Pierre Vermaut, Philipe Sevin, Philippe Renie, Paul Lippens, Alain Englebert, Bruno Lambert, Jean Ducroux, Regnier Haegelsteen, Bruno Lambert,

47	GALAPAGOS	Raj Parekh, Onno Van de Stolpe, Ferdinand Verdonck, Harrold van Barlingen, Ronald Brus, Werner Cautreels, Howard Rowe,
48	GBL	Albert Frere, Paul Desmarais, Gerald Frere, Thierry de Rudder, Georges Chodron de Courcel, Victor Delloye, Paul Desmarais Jr, Ian Gallienne, Michel Plessis Belair, Gilles Samyn, Amaury de Seze, Arnaud Vial, Jean Louis Beffa, Maurice Lippens, Jean Stephenne, Gunter Thielen,
49	GDF SUEZ	Gerard Mestrallet, Jean Francois Cirelli, Albert Frere, Edmond Alphandery, Jean Louis Beffa, Aldo Cardoso, Rene Carron, Paul Desmarais Jr, Anne Lauvergeon, Thierry de Rudder, Simon of Highbury, Jean Paul Bailly, Olivier Bourges, Pierre Franck Chevet, Ramon Fernandez, Pierre Graff, Pierre Mongin, Alain Beullier, Anne Marie Mourer, Patrick Petitjean, Gabrielle Prune,
50	GIMV	Herman Daems, Koen Dejonckheere, Leo Victor, Dirk Boogmans, Greet De Leenheer, Christ'l Joris, Jan Kerremans, Sophie Manigart, Martine Reynaers, Eric Spiessens, Emile van der Brug, Bart van Hooland,
51	GLOBAL GRAPHICS	Johan Volckaerts, Gary Fry, Alain Pronost, Gareth Jones, Pierre Van Beneden,
52	HAMON	Philippe Bodson, Francis Lambilliotte, Jacques Lambilliotte, Jean Hamon, Bernard Lambilliotte, Sabine Colson, Pierre Meyers, Martin Gonzalez del Valle,
53	HENEX	Yves Boel, Donald Fallon, Richard Goblet d'Alviella, Jacques Boel, Karl Choquet, Renaud de Kerchove de Denterghem, Thierry d'Udekem d'Acoz,
54	HOME INVBELG SIFI	Michel Pleeck, Xavier Mertens, Guillaume Botermans, Luc Delfosse, Gaetan Hannecart, Lievin Van Overstraeten, Guy Van Wymersch,
55	IRIS GROUP	Pierre De Muelenaere, Etienne Van de Kerckhove, Pierre Sonveaux, Gerard Constant, Jean Louis Gregoire, Thierry Marchandise, Michel Claus,
56	IBA	Jean Stephenne, Yves Windelincx, Pierre Scalliet, Pierre Mottet, Yves Jongen, Eric de Lamotte, Peter Vermeeren, Olivier Ralet, Nicole Destexhe,
57	IBT	Andreas Eckert, Edgar Loffler, Gunnar Mann, Andre Hess, Frank Perschmann, Holger Burk, Hans Jorg Hinke, Martin Holscher, Dick Schoolenberg, Edwin Vandermeulen,
58	IMMO MOURY	Willy Legros, William Ancion, Claude Desseille, Georges Moury, Gilles Olivier Moury,
59	IMMOBEL	Paul Buysse, Gaetan Piret, Didier Bellens, Maciej Drozd, Maciej Dyjas, Marc Grosman, Luc Luyten, Marek Modecki, Wilfried Verstraete, Laurent Wasteels,
60	ING GROEP	Jan Hommen, Patrick Flynn, Koos Timmermans,
61	INTERVRETAIL	Jean Pierre Blumberg, Nick van Ommen, Chris Peeters, Taco de Groot, Hubert Roovers, Tom de Witte,
62	INTERVEST OFFICES	Paul Christiaens, Jean Pierre Blumberg, Nick van Ommen, Chris Peeters, Reinier van Gerrevink, Wim Fieggen, Taco de Groot,
63	JENSEN GROUP	Raf Decaluwe, Jesper Munch Jensen, Jorn Munch Jensen, Hans Werdelin, Luc Van Nevel, Erik Vanderhaegen,

64	KBC	Jan Huyghebaert, Philippe Vlerick, Jan Vanhevel, Paul Borghgraef, Alain Bostoen, Jo Cornu, Marc De Ceuster, Franky Depickere, Luc Discry, Frank Donck, Jean Pierre Hansen, Dirk Heremans, Lode Morlion, Philippe Naert, Luc Philips, Theodoros Roussi, Hendrik Soete, Eric Stroobants, Alain Tytgadt, Ghislaine Van Kerckhove, Charles Van Wymeersch, Piet Vanthemsche, Marc Wittemans,
65	KBC ANCORA	Franky Depickere, Luc Discry, Jean Francois Dister, Johan Massy, Peter Muller, Jos Plessers, Ghislaine Van Kerckhove, Cynthia Van Hulle, Leopold Bragard, Katelijn Callewaert, Herman Vandaele,
66	KEYWARE TECH	Guido Van der Schueren, Pierre Delhaize, Guido Wallebroek, Bruno Kusters, Luc Pintens, Stephane Vandervelde,
67	KINEPOLIS GROUP	Philip Ghekiere, Joost Bert, Eddy Duquenne, Marie Suzanne Bert Vereecke, Rafael Decaluwe, Marion Debruyne, Geert Vanderstappen, Marc van Heddeghem,
68	LEASINVEST	Eric De Keuleneer, Bernard de Gerlache de Gomery, Christophe Desimpel, Marcus Van Heddeghem, Luc Bertrand, Jan Suykens, Jean Louis Appelmans, Kris Verhellen, Guy Van Wymersch Moons, Thierry Rousselle, Alfred Bouckaert,
69	LOTUS BAKERIES	Karel Boone, Matthieu Boone, Jan Vander Stichele, Jan Boone, Johan Boone, Anton Stevens, Jean Luc Dehaene, Herman Van de Velde, Johan Lokhost, Benoit Graulich, Dominique Leroy,
70	MDXHEALTH	Edward L Erickson, Jan Groen, Mark Myslinski, Hilde Windels, Raphael Wisniewski, Denis Biju Duval, Karin Dorrepaal,
71	MEDIVISION	Noam Allon, Yigal Berman, Doron Maor, Mira Nesher, Miri Krebs, Amnon Rofe,
72	MELEXIS	Roland Duchätelet, Francoise Chombar, Rudi De Winter, Steve Hix, Lina Sarro, Jenny Claes,
73	MIKO	Stef Michielsen, Frans Van Tilborg, Jan Michielsen, Frans Michielsen, Patrick Michielsen, Franky Depickere, Flor Joosen, Chris Van Doorslaer, Mark Stulens,
74	MOBISTAR	Jan Steyaert, Bertrand du Boucher, Brigitte Bourgoin, Aldo Cardoso, Olaf Swantee, Gerard Ries, Benoit Scheen, Philippe Delaunois, Eric Bauche, Nathalie Clere, Eric Dekeuleneer, Christina von Wackerbarth,
75	MONTEA	Gerard Van Acker, Hugo Van hoof, Jo De Wolf, Dirk De Pauw, Andre Bosmans, Christian Terlinden, Eddy Hartung, Philip Van gestel, Peter Snoeck, Carlos Bourgeois,
76	MOPOLI	Hubert Fabri, Philippe De Traux, Robert de Theux, Daniel Haas,
77	MOURY CONSTRUCT	Georges Moury, Gilles Olivier Moury, Jean Paul Feldbusch, Francis Lemmens, Edgar Hollange, Michel Mersch,
78	NAT PORTEFEUIL	Gilles Samyn, Victor Delloye, Gerald Frere, Jean Clamon, Thierry Dormeuil, Christine Frere Hennuy, Segolene Galienne, Thierry de Rudder, Donald Bryden, Robert Castaigne, Jean Pierre Hansen, Siegfield Luther,
79	NEUFCOUR FIN	Jacques Janssen, Noel Dessard, Pierre Galand, Nathalie Galand, Maurice Charles Dalmagne, Philippe Hault,
80	NYRSTAR	Julien De Wilde, Roland Junck, Peter Mansell, Ray Stewart, Karel Vinck, Oyvind Hushovd,
81	OIM	Marius Ritskes, Thomas Ackerly, Jos E Haag, Reinhard Krafft, Michael Hartung,
82	OMEGA PHARMA	Lucas Laureys, Benoit Graulich, Jan Boone, Chris Van Doorslaer, Karel Van Eetvelt, Marc Coucke, Sam Sabbe,

83	OPTION	Olivier Lefebvre, Jan Callewaert, Philip Vermeulen, Lawrence Levy, David A Hytha,
84	PARC PARADISIO	Eric Domb, Yvan Moreau, Steffen Patzwahl, Pierre De Muelenaere, Frederic Deveen, Pierre Rion, Thierry Balot, Rene Smet, Alain Declerq, Michel Lemay, Pierre Sonveaux,
85	PAYTON PLANAR	David Yativ, Michael Peretz, Alexander Timashov,
86	PCB	Claude Castells, Philippe Lacroix, Alain Maillot, Pascal Fournier Montgieux, Luc F Meurrens, Jean Marie Limpens,
87	PICANOL	Stefaan Haspeslagh, Hugo Vandamme, Francois Meysman, Jean Pierre Dejaeghere, Patrick Steverlynck, Luc Tack,
88	PINGUINLUTOSA	Herwig Dejonghe, Koen Dejonghe, Guy Van den Broeke, Veerle Deprez, Jo Breesch, Luc Van Nevel, Marc Ooms, Luc Vandewalle, Patrick Moermans,
89	PUNCH INT	Guido Segers, Arthur Vanhoutte, Gerda Gysel, Wim Deblauwe, Wim Maes,
90	QUESTFOR GR	Jos B Peeters, Diego du Monceau de Bergendal, Johan Tack, Rene Avonts, Philippe Haspeslagh, Edward Claeys, Michel Akkermans, Frans L Theeuwes, Rudi Marien, Koenraad Debackere, Dirk Vanderschrick,
91	REALDOLM	Michel Akkermans, Bruno Segers, Dimitri Duffeleer, Jef Colruyt, Wim Colruyt, Filip Roodhooft, Gaetan Hannecart, Thierry Janssen,
92	RECTICEL	Etienne Davignon, Luc Vansteenkiste, Olivier Chapelle, Pol Bamelis, Vincent Doumier, Henk Janssen, Guy Paquot, Jean Jacques Sioen, Wilfried Vandepoel, Tonny Van Doorslaer, Louis H Verbeke, Klaus Wendel, Luc Willame,
93	RENTABILIWEB	Jean Baptiste Descroix Vernier, Corinne Chatal, Thibaut Faures Fustel de Coulanges, Jean Marie Messier, Eric Licoys, Gilles Lioret,
94	RESILUX	Alex De Cuyper, Dirk De Cuyper, Peter De Cuyper, Dirk Lannoo, Guido Vanherpe, Francis Vanderhoydonck,
95	RETAIL EST	Paul Borghgraef, Jan De Nys, Luc Geuten, Yvan Lippens, Jean Louis Appelmans, Hubert De Peuter, Victor Ragoen, Marc Tinant, Sophie Lambrights,
96	RHJ INTERNATIONAL	Ronald Daniel, Timothy C Collins, Leonhard Fischer, Harvey Golub, Mathias Dopfner, Bjorn Konig, Jun Makihara, Gerd Häusler, Jeremy W Sillem,
97	ROSIER	Francis Raatz, Francoise Leroy, Eric Vardon, Daniel Richir, Robert JF Semoulin, Nicolas David, Michel Armand Bonnet, Laurent Verhelst,
98	ROULARTA	Hugo Vandamme, Rik De Nolf, Leo Claeys, Lieve Claeys, Caroline De Nolf, Carel Bikkers, Marleen Vaesen, Marc Verhamme,
99	RTL GROUP	Siegfried Luther, Martin Taylor, Gerhard Zeiler, Gunther Gruger, Hartmut Ostrowski, Thomas Rabe, James Singh, Jacques Santer,
100	SABCA	R Pellichero, C Edelstenne, G Piras, L Segalen, S Vollebregt, H Valk, J de Smet,
101	SAINT GOBAIN	Pierre Andre de Chalendar, Jean Louis Beffa, Isabelle Bouillot, Robert Chevrier, Gerhard Cromme, Bernard Cusenier, Jean Martin Folz, Bernard Gautier, Sylvia Jay, Frederic Lemoine, Gerard Mestrallet, Michel Pebereau, Denis Ranque, Gilles Schnepp, Jean Cyril Spinetta,

102	SAPEC	Eduardo Catroga, Antoine Velge, Philippe de Broqueville, Manuel Fernando Espirito Santo, Jean Marie Laurent Josi, Xavier Scheyven, Gunter Strauss, Christian Varin, Patricia Velge,
103	SVK	Johan De Schryver, Bart Van Aelst, Pierre Vercruysse, Philippe Woitrin, Andreas De Schryver, Walter Verhaert, Michel Verhaert, Jacques De Schryver, Leo De Schryver,
104	SERVICEFLATS	Mark Suykens, Willy Pintens, Myriam Lint, Bart De Bruyn, Dirk Van den Broeck, Rudy Degrande, Hubert De Peuter, Peter Heukelom, Alfons Blondeel,
105	SIOEN	Luc Vansteenkiste, Michele Sioen, Jacqueline Sioen Zoete, Danielle Parein Sioen, P Sioen, Pol Bamelis, Wilfried Vandepoel, Louis Verbeke, Luc Vandewalle,
106	SIPEF	Theo Bracht, Francois Van Hoydonck, Luc Bertrand, Priscilla Bracht, Bernard de Gerlache de Gomery, Antoine Friling, Regnier Haegelsteen, Richard Robinow,
107	SOFINA	Yves Boel, Richard Goblet d'Alviella, Harold Boel, Nicolas Boel, Francois Cornelis, Etienne Davignon, Dominique Lancksweert, Robert Peugeot, David Verey, Michel Tilmant,
108	SOLVAC	Jean Pierre Delwart, Bernard de Laguiche, Jean Patrick Mondron, Bruno Rolin, Patrick Solvay, Francois Xavier de Dorlodot, Marc Emil Janssen, Rene Louis de bernis Calviere, Yvonne Boel, John Kraft de la Saulx, Aude Thibaut de Maisieres, Alain Semet,
109	SOLVAY	Aloïs Michielsen, Denis Solvay, Christian Jourquin, Bernard de Laguiche, Jean Marie Solvay, Guy de Selliers de Moranville, Nicolas Boel, Jean van Zeebroeck, Jean Martin Folz, Bernard Scheuble, Anton van Rossum, Charles Casimir Lambert, Herve Coppens d'Eeckenbrugge, Petra Mateos Apericio Morales, Evelyn du Monceau, Yves Thibault de Silguy,
110	SPADEL	Pierre Drion, Marc du Bois, Fr Chaffart, Louis Greindl, Johnny Thijs, Frank Meysman, Jean Vandemoortele,
111	SPECTOR	Tonny Van Doorslaer, Philippe Vlerick, Luc Vansteenkiste, Jonas Sjogren, Patrick De Greve, Geert Vanderstappen, Norbert Verkimpe, Christophe Levie, Stef De corte,
112	SUCRAF	Paul Kronacker, H Kronacker, Jef van de Weyer, E Muuls, Quentin Kronacker, Thomas Preston, Guido Wallebroeck,
113	SUEZ	Jean Louis Chaussade, Gerard Mestrallet, Gerald Arbola, Alain Chaigneau, Gerard Lamarche, Nicolas Bazire, Jean Francois Cirelli, Guillaume Pepy, Penelope Chalmers, Lorenz d'Este, Olivier Pirotte, Gilles Benoist, Amaury de Seze, Ezra Suleiman, Valerie Bernis, Patrick Ouart, Jerôme Tolot, Harold Boel,
114	SYSTEMAT	Jean Claude Loge, Bernard Lescot, Nicolas Loge, Pierre Herpain, Jacques Ghyselbrecht, Jean Luc Henry, Jacques Voisin,
115	TELENET	Frank Donck, Alex Brabers, Charles Bracken, Niall Curran, Michel Delloye, Julien De Wilde, Bernard Dvorak, Diederik Karsten, Manuel Kohnstamm, Gene Musselman, James S O'Neill, Ruth Pirie, James Ryan, Andre Sarens, Duco Sickinghe, Friso van Oranje, Michel Alle, Jozef Roos, Guido De keersmaecker,
116	TER BEKE	Luc De Bruyckere, Marc Hofman, Frank Coopman, Dominique Coopman, Louis H Verbeke, Eddy Van der Pluym, Luc Vansteenkiste, Vincent Doumier, Willy Delvaux, Thierry Balot, Jules Noten,

117	TESSENDERLO	Gerard Marchand, Frank Coenen, Michel Nicolas, Francois Schwartz, Antoine Gendry, Valere Croes, Paul de Meester, Jaak Gabriels, Baudouin Michiels, Barnard Pache, Thierry Piessevaux, Alain Siaens, Karel Vinck,
118	TEXAF	Philippe Croonenbergs, Bernard de Gerlache de Gomery, Albert Yuma Mulimbi, Jean Philippe Waterschoot,
119	THENERGO	Norbert Van Leuffel, Olivier Dellacherie, Johan Keppens, Yann Massoulier, Marc Rosiers,
120	THINK MEDIA	Isidoor Claes, Erik Maes, Maurice De Velder, Guido Van der Schueren, Rudy Van Thuyne, Laurent Warlop, Ann Nisot,
121	THROMBOGENICS	Desire Collen, Chris Buyse, Landon T Clay, Jean Luc Dehaene, Patrik De Haes, Luc Philips, Staf Van Reet,
122	TIGENIX	Willy Duron, Koenraad Debackere, Gil Beyen, Frank P Luyten, Sven Andreasson, Luc Van de Steen,
123	TOTAL	Christophe de Margerie, Thierry Desmarest, Patrick Artus, Patricia Barbizet, Daniel Bouton, Gunnar Brock, Claude Clement, Paul Desmarais Jr, Bertrand Jacquillat, Anne Lauvergeon, Levene of Portsoken, Claude Mandil, Michel Pebereau, Thierry de Rudder,
124	TRANSICS	Walter Mastelinck, Luc Vandewalle, Ana Vizcaino, Tom Dechaene, Vladimir Lasocki, Peter Leyman, Rudy Everaert,
125	TUBIZE FIN	Daniel Janssen, Evelyn du Monceau, Cedric van Rijckevorsel, Cyril Janssen, Francois Tesch,
126	UCB	Karel Boone, Evelyn du Monceau, Roch Doliveux, Armand De Decker, Bert De Graeve, Peter Fellner, Norman J Ornstein, Jean Pierre Kinet, Thomas Leysen, Gerhard N Mayr, Tom McKillop, Arnoud de Pet Roose de Calesberg, Alexandre Van Damme, Jean van Rijckevorsel, Gaetan van de Werve,
127	UMICORE	Thomas Leysen, Marc Grynberg, Isabelle Bouillot, Uwe Ernst Bufe, Aroud de Pret, Shohei Naito, Guy Paquot, Klaus Wendel, Jonathan Oppenheimer, Jean Luc Dehaene,
128	UNIBRA	Baudouin Michiels, Maïte Relecom, Jean Louis Henkens, Olivier Lippens, Jean Louis Home, Thibault Relecom, Berangere Relecom,
129	VAN DE VELDE	Lucas Laureys, Herman Van de Velde, Benedicte Laureys, Ignace Van Doorselaer, Marc Hofman, Benoit Graulich, Dirk Goeminne,
130	VGP	Marek Sebestak, Alexander Saverys, Jos Thys, Jan Van Geet, Bart Van Malderen,
131	VPK PACKAGING	Jean Paul Macharis, Pierre Macharis, Jozef Schoonjans, Michel Delbaere, Carl Verstraelen, Bruno Accou, Dirk Meeus, Denis Zenner,
132	VRANKEN POMMERY	Paul Francois Vranken, Roger Viatour, Roger Rocassel, Vincent Girard, Dominique Pichart, Jean Pierre Chevallier, Michel Fortin, Christian Germain, Jacques Gauthier, Paul Bamberger, Maïlys Vranken Thierry,
133	WAREHOUSES SICAFI	Robert Wagner, Jean Claude Duchateaux, Jean Pierre Gerard, R Laurent Wagner, Caroline Wagner, Christian Jacqmin, Valerie Wagner,
134	WAREHOUSES DEPAUW	Mark Duyck, Frank Meysman, Alex Van Breedam, Dirk Van den Broeck, Tony De Pauw, Joost Uwents,
135	WERELDHAVE	J Pars, Benoit Graulich, B De Corte, P Rasschaert,
136	ZENITEL	Frank Donck, Eugeen Beckers, Kenneth Dastol, Eric Van Zele, Duco Sickinghe, Jo Van Gorp,

137	ZETES INDUSTRIES	Jean Francois Jacques, Alain Wirtz, Pierre Lambert, Floris Vansina, Olivier Gernay, Paul Jacques, Jean Marie Laurent Josi, Alexandre Schmitz, Jose Charles Zurstrassen

Appendix 3.2 List of directors (2016)

Table 25: List of directors per company (2016)

	Company Name	*Name of the Board Members*
1	4ENERGY INVEST	Filip Lesaffer, Philiep Van Eeckhout,Stijn Bijnens, Henri Meyers, Jo Breesch, Frank Bruyneel, Jo Buekens,
2	AB INBEV	Maria Asuncion Aramburuzabala, Martin J Barrington, Alex Behring, Michele Burns, Paul Cornet de Ways Ruart, Stefan Descheemaeker, Gregoire de Spoelberch, William F. Gifford, Olivier Goudet, Paulo Lemann, Elio Leoni Sceti, Alejandro Santo Domingo, Carlos Alberto da Veiga Sicupira, Marcel Herrmann Telles, Alexandre Van Damme,
3	ABLYNX	Peter Fellner, Edwin Moses, Russell Greig, Bo Jesper Hansen, William Jenkins, Catherine Moukheibir, Remi Vermeiren, Lutgart Van den Berghe,
4	ABO GROUP	Gerard Van Acker, Ivo Van Vaerenbergh, Jan Gesquière, Frank De Palmenaer,
5	ACCENTIS	Jacques De Bliek, Gerard Cok, Gerda Gysel, Bruno Holthof, Mieke De Clercq,
6	ACKERMANS & VAN HAAREN	Luc Bertrand, Alexia Bertrand, Marion Debruyne, Jacques Delen, Valerie Jurgens, Pierre Macharis, Julien Pestiaux, Thierry van Baren, Frederic van Haaren, Pierre Willaert,
7	AEDIFICA	Serge Wibaut, Stefaan Gielens, Jean Kotarakos, Jean Franken, Eric Hohl, Katrien Kesteloot, Sophie Maes, Elisabeth May-Roberti, Adeline Simont,
8	AGEAS	Jozef De Mey, Antonio Cano, Bart De Smet, Christophe Boizard, Filip Coremans, Guy de Selliers de Moranville, Richard Jackson, Jane Murphy, Roel Nieuwdorp, Lionel Perl, Lucrezia Reichlin, Jan Zegering Hadders, Yvonne Lang Ketterer,
9	AGFA-GEVAERT	Julien De Wilde, Michel Akkermans, Jo Cornu, Willy Duron, Hilde Laga, Viviane Reding, Christian Reinaudo, Wilfried Van Lishout,
10	AHOLD DELHAIZE	Mats Jansson, Jan Hommen, Jacques de Vaucleroy, Jack Stahl, Ben Noteboom, Bill McEwan, Rob van den Bergh, Stephanie Shern, Mark McGrath, René Hooft Graafland, Mary Anne Citrino, Johnny Thijs, Patrick De Maeseneire, Dominique Leroy,
11	APERAM	Lakshmi Mittal, Aditya Mittal, Philippe Darmayan, Romain Bausch, Joseph Greenwell, Kathryn A. Matthews, Laurence Mulliez,
12	ARGENX	Peter Verhaeghe, Donald deBethizy, Pam Klein, John de Koning, David Lacey, Werner Lanthaler, Tim Van Hauwermeiren, Eric Castaldi,
13	ASCENCIO	Carl Mestdagh, Fabienne D'Ans, Serge Fautre, Benoit Godts, Jean-Luc Calonger, Damien Fontaine, Yves Klein, Laurence Deklerck,

14	ASIT	Béatrice De Vos, Thierry Legon, Gerd Zettlmeissl, Jean Duchateau, Francois Meurgey, Everard van der Straten, Marc Foidart, Henri De Meyer, Yves Desiront,
15	ATENOR	Frank Donck, Stephan Sonneville, Charles-Louis d'Arenberg, Marc De Pauw, Emmanuele Attout, Michele Grégoire, Jacquot Schwertzer, Nadine Lemaitre, Philippe Vastapane, Luc Bertrand,
16	AVANTIUM	Tom van Aken, Frank Roerink, Bart Berenbak, Steven Olivier, Michiel Boersma, Frits Dautzenberg, Philip Smith, Leo Manzer, John Geus,
17	BANIMMO	Maryse Aulagnon, Alain Chaussard, Cyril Aulagnon, Patrick Mertens de Wilmars, Didrik van Caloen, Dominique de Ville de Goyet, Patrick Buffet, Jacques-Etienne de T'Serclaes, Emmanuel van Innis, Didier Malherbe, Catherine Sabouret, Andre Bosmans,
18	BANQUE NAT BELGE	Gerlad Frère, Didier Matray, Rudy De Leeuw, Karel Van Eetvelt, Michele Detaille, Jean Francois Cats, Marc Leemans, Pieter Timmermans, Pieter Verhelst, Jean Francois Robe
19	BARCO	Charles Beauduin, Eric Van Zele, Antoon De Proft, Bruno Holthof, Luc Missorten, Jan Oosterveld, Christina von Wackerbarth, Ashok Jain, Hilde Laga, Frank Donck, Kurt Verheggen,
20	BEFIMMO	Alain Devos, Benoit De Blieck, Barbara De Saedeleer, Kurt De Schepper, Hugues Delpire, Etienne Dewulf, Sophie Goblet, Benoit Godts, Sophie Malarme-Lecloux, Guy Van Wymersch-Moons,
21	BEKAERT	Gregory Dalle, Matthew Taylor, Bert De Graeve, Alan Begg, Leon Bekaert, Charles de Liedekerke, Francois de Visscher, Manfred Wennemer, Hubert Jacobs van Merlen, Maxime Jadot, Celia Baxter, Christophe Jacobs van Merlen, Emilie van de Walle de Ghelcke, Henri Jean Velge, Barbara Judge, Martina Merz, Mei Ye, Pamela Knapp, Bernard van de Walle de Ghelcke, Baudouin Velge,
22	BELRECA	Michel van de Put, Didier Gilles de Pelichy, Arnaud van de Put, Eric van de Put,
23	BELUGA	Dirk Geerinckx, Bruno Lippens, Serge Stroinovsky, Phillippe Weill, Michel Balieus, Francois Vogeleer, Guido Wallebroek,
24	BIOCARTIS	Rudi Pauwels, Hilde Windels, Rudi Marien, Roald Borre, Peter Piot, Renaat Berckmoes, Mark Shaffar, Hilde Eylenbosch,
25	BONE THERAPEUTICS	Michel Helbig de Balzac, Roland Baron, Chris Buyse, Paul Magrez, Marc Nolet de Brauwere van Steeland, Thierry Francois, Jean-Jacques Verdickt, Jean-Paul Prieels, Thomas Lienard, Wim Goemaere,
26	BPOST	Francoise Masai, Koen Van Gerven, Arthur Goethals, Luc Lallemand, Laurent Levaux, Caroline Ven, Francois Cornelis, Sophie Dutordoir, Bruno Holthof, Ray Stewart, Michael Stone, Bernadette Lambrechts,
27	BREDERODE	Pierre van der Mersch, Luigi Santambrogio, Axel van der Mersch, Michel Delloye, Bruno Colmant,
28	CAMPINE	Friedrich-Wilhelm Hempel, Patrick De Groote, Andre Hempel, Geert Krekel, Hans-Rudolf Orgs, Christian Dewulf, Willem De Vos,
29	CARE PROPERTY INVEST	Mark Suykens, Willy Pintens, Dirk Van den Broeck, Peter Van Heukelom, Myriam Lint, Lode De Vrieze, Brigitte Grouwels, Carol Riske, Kristien Van der Hasselt, Paul Van Gorp, Lode Verstraeten,

30	CELYAD	Michel Lussier, Chris Buyse, Rudy Dekeyser, Serge Goblet, Debasish Roychowdhury, Chris De Jonghe, Hanspeter Spek, Christian Homsy,
31	CENERGY	Jacques Moulaert, Efstratios Thomadakis, Xavier Bedoret, Simon Macvicker, Joseph Rutkowski, Margaret Zakos, William Gallagher,
32	CFE	Renaud Bentegeat, Piet Dejonghe, Alain Bernard, John-Eric Bertrand, Philippe Delusinne, Leen Geirnaerdt, Koen Janssen, Christian Labeyrie, Ciska Servais, Jan Suykens,
33	CIE BOIS SAUVAGE	Frederic van Gansberghe, Pierre-Yves Laminne, Isabelle Hamburger, Massimo Boulvain, Hubert Olivier, Valerie Paquot, Patrick Van Craen,
34	COFINIMMO	André Bergen, Jean-Edouard Carbonnelle, Jerome Descamps, Xavier Denis, Francoise Roels, Xavier de Walque, Maurice Gauchot, Kathleen Van Den Eynde, Olivier Chapelle, Alain Schockert, Ines Reinmann-Toper, Diana Monissen, Christophe Demain,
35	COLRUYT	Jef Colruyt, Frans Colruyt, Francois Gillet, Piet Colruyt, Wim Colruyt, Willy Delvaux, Astrid De Lathauwer, Jean de Leu de Cecil,
36	CONNECT GROUP	Dominique Moorkens, Willy Hendrickx, Peter Watteeuw, Bernard Delvaux, Klaus Kroesen, Luc Switten, Hubert Baren, Dimitri Duffeleer, Guy van Dievoet,
37	CURETIS	William Rhodes, Mario Crovetto, Werner Schäffer, Prabhavathi Fernandes, Rudy Dekeyser, Holger Reithinger,
38	D'IETEREN	Roland D'Ieteren, Nicolas D'Ieteren, Olivier Perier, Axel Miller, Pierre-Olivier Beckers, Christine Blondel, Michele Sioen, Pascal Minne, Denis Pettiaux, Frederic de Vuyst, Michel Alle,
39	DALENYS	Jean-Baptiste Descroix-Vernier, Thibaut Faures Fustel de Coulanges, Corinne Chatal, Jean-Marie Messier, Georges Pauget, Gilles Lioret, Frank Esser, Francois Momboisse,
40	DECEUNINCK	Paul Thiers, Francis Van Eeckhout, Francois Gillet, Pierre Alain De Smedt, Marcel Klepfisch, Benedikte Boone, Evelyn Deceuninck, Anouk Lagae,
41	DELTA LLOYD	Rob Ruijter, Eric Fischer, Andre Bergen, Jan Haars, Fieke van der Lecq, John Lister, Paul Nijhof, Clara Christina Streit,
42	DEXIA	Robert de Metz, Wouter Devriendt, Corso Bavagnoli, Johan Bohets, Bart Bronselaer, Alexandre De Geest, Thierry Francq, Veronique Huques, Alexandra Serizay, Lucie Muniesa, Michel Tison, Koen Van Loo,
43	ECKERT ZIEGLER	Wolfgang Maennig, Helmut Grothe, Gudrun Erzgräber, Detlev Ganten, Nikolaus Fuchs, Hans-Jörg Hinke,
44	ECONOCOM	Jean-Louis Bouchard, Bruno Grossi, Robert Bouchard, Veronique Di Benedetto, Georges Croix, Rafi Kouyoumdjian, Gaspard Durrleman, Jean-Philippe Roesch, Walter Butler, Philippe Capron, Adeline Chamon-Kemoun, Anne Lange, Marie-Christine Levet, Jean Mounet,
45	ELIA	Miriam Maes, Claude Gregoire, Geert Versnick, Michel Alle, Jacques de Smet, Luc De Temmerman, Frank Donck, Cecile Flandre, Philip Heylen, Luc Hujoel, Jane Murphy, Dominique Offergeld, Saskia Van Uffelen, Peter Vanvelthoven,

46	EMAKINA	Denis Steisel, Brice Le Blevennec, Karim Chouikri, John Deprez, Pierre Gatz, Francois Gillet, Pierre-Michel Cattoir, Anne Pinchart, Daisy Foquet,
47	ENGIE	Gerard Mestrallet, Isabelle Kocher, Ann-Kristin Achleitner, Edmond Alphandery, Fabrice Bregier, Aldo Cardoso, Barbara Kux, Francoise Malrieu, Marie-Jose Nadeau, Ricketts of Shortlands, Patrice Durand, Catherine Guillouard, Mari-Noëlle Jego-Laveissiere, Lucie Muniesa, Stephane Pallez, Alain Beullier, Philippe Lepage, Olivier Marquer, Caroline Simon, Laurent Michel, Florence Tordjman,
48	ENVIPCO	Bhajun Santchurn, Christian Crepet, Gregory Garvey, Guy Lefebvre, Alexandre Bouri, David D'Addario,
49	EURONAV	Carl Steen, Patrick Rodgers, Daniel Bradshaw, William Thomson, Alice Wingfield Digby, Anne-Helene Monsellato, Ludovic Saverys, Grace Reksten Skaugen,
50	EURONEXT	Rijnhard Van Tets, Dick Sluimers, Dominique Aubernon, Koenraad Dom, Ramon Fernandez, Manuel Ferreira da Silva, Jim Gollan, Kerstin Günther, Lieve Mostrey,
51	EVS	Patrick Tillieux, Michel Counson, Muriel De Lathouwer, Christian Raskin, Freddy Tacheny, Yves Trouveroy, Martin De Prycker,
52	EXMAR	Philippe Bodson, Nicolas Saverys, Ludwig Kriel, Patrick De Brabandere, Jens Ismar, Michel Delbaere, Philippe Vlerick, Pauline Saverys, Ariane Saverys, Howard Gutman, Barbara Saverys,
53	FAGRON	Robert Peek, Johannes Stols, Karin de Jong, Giulia Van Waeyenberge, Koen Hoffman, Frank Vlayen, Matthias Geyssens, Nathalie Clybouw, Marc Janssens, Marc Coucke, Michael Schenk,
54	FLORIDIENNE	Philippe Bodson, Loic Waucquez, Yves Blanpain, Paul Cornet de Ways Ruart, Olivier Davignon, Bernard De Gerlache De Gomery, Philippe De Spoelberch, Peter Lenoir, Yves Meurice, Gaetan Waucquez, Lionel de Hemptinne,
55	FLUXYS	Daniel Termont, Claude Gregoire, Jos Ansoms, Patrick Cote, Andries Gryffroy, Luc Hujoel, Ludo Kelchtermans, Renaud Moens, Josly Piette, Nele Roobrouck, Christian Viaene, Luc Zabeau, Marianne Basecq, Valentine Delwart, Helene Deslauriers, Monique Lievens, Walter Nonneman, Henriette Van Caenegem, Sandra Wauters,
56	FNG	Emmanuel Bracke, Tine De Ryck, Emiel Lathouwers, Anja Maes, Dieter Penninckx, Gino Van Ossel, Eric Verbaere,
57	FOUNTAIN	Anne Sophie Pijcke, Pierre Gillis, Michel Malschalck, Sorin Mogosan, Eugeen Beckers, Christian Van Besien,
58	GALAPAGOS	Raj Parekh, Onno van de Stolpe, Harrold van Barlingen, Werner Cautreels, Howard Rowe, Katrine Bosley, Christine Mummery, Mary Kerr,
59	GBL	Gerald Frere, Paul Desmarais, Thierry de Rudder, Ian Gallienne, Gerard Lamarche, Antoinette d'Aspremont Lynden, Victor Delloye, Paul Desmarais III, Cedric Frere, Segolene Gallienne, Maurice Lippens, Christine Morin-Postel, Michel Plessis-Belair, Marie Polet, Gilles Samyn, Amaury de Seze, Martine Verluyten, Arnaud Vial,
60	GENKYOTEX	Claudio Nessi, Ilias Papatheodorou, Jesus Martin Garcia, Gilles Nobecourt, Catherine Moukheibir, Mary Tanner, Stephane Verdood, Joseph McCracken,

61	GIMV	Hilde Laga, Koen Dejonckheere, Dirk Boogmans, Brigitte Boone, Marc Descheemaecker, Manon Janssen, Christ'l Joris, Sophie Manigart, Luc Missorten, Geert Peeters, Karel Plasman, Bart Van Hooland,
62	GLOBAL GRAPHICS	Guido Van der Schueren, Gary Fry, Graeme Huttley, Johan Volckaerts,
63	GREENYARD	Hein Deprez, Hilde Laga, Veerle Deprez, Thomas Borman, Marc Ooms, Charles-Henri Deprez, Dirk Van Vlaenderen, Johan Vanovenberghe, Marleen Vaesen, Marc Wittemans, Aalt Dijkhuizen,
64	HAMON	Philippe Bodson, Francis Lambilliotte, Aline Lambilliotte, Bernard Lambilliotte, Valerie Potier, Martin Gonzalez del Valle, Philippe Vlerick, Alexandre Grosjean, Renaud Witmeur, Laurent Levaux,
65	HOME INVEST	Lievin Van Overstraeten, Eric Spiessens, Sophie Lambrighs, Wim Aurousseau, Koen Dejonckheere, Johan Van Overstraeten, Laurence de Hemptinne,
66	IBA	Sybille Van Den Hove, Mary Gospodarowicz, Marcel Miller, Kathleen Vandeweyer, Olivier Legrain, Yves Jongen, Pierre Mottet, Jeroen Cammeraat, Eric de Lamotte,
67	IEP INVEST	Dirk Van Vlaenderen, Gerda Gysel, Arthur Vanhoutte,
68	IMMO BEAULIEU	Kim Creten, Hubert De Peuter, Beatrijs De Wolf, Dominique Labay, Pascal Minne, Didier Snyers d'Attenhoven, Carine van Bever, Alain Van Lauwe,
69	IMMO LUX AIRPORT	Claudine Leinenveber, Kim Creten, Hubert De Peuter, Beatrijs De Wolf, Carine van Bever, Frans Vanderstappen,
70	IMMO MOURY	Willy Legros, Georges Moury, Gilles-Olivier Moury, William Ancion, Claude Desseille,
71	IMMOBEL	Marnix Galle, Alexander Hodac, Astrid De Lathauwer, Karin Koks - Van der Sluijs, Sophie Lambrighs, Pierre Nothomb, Annick Van Overstraeten, Piet Vercruysse, Jacek Wachowicz,
72	ING	Eric Boyer de la Giroday, Erik Van Den Eynden, Krista Baetens, Tanate Phutrakul, Philippe Wallez, Frank Stockx, Johan Kestens, Emmanuel Verhoosel, Pinar Abay, Philippe de Buck van Overstraeten, Luc Bertrand, Christian Jourquin, Diego du Monceau de Bergendal, Paul Mousel, Koos Timmermans,
73	INTERVEST	Jean-Pierre Blumberg, Chris Peeters, Jacqueline de Rijk - Heeren, Marleen Willekens, Johan Buijs, Gunther Gielen,
74	JENSEN GROUP	Raf Decaluwé, Inge Buyse, Jobst Wagner, Peter Norregaard, Jesper Munch Jensen, Hans Kristian Werdelin,
75	KBC	Thomas Leysen, Philippe Vlerick, Alain Bostoen, Katelijn Callewaert, Sonja De Becker, Franky Depickere, Frank Donck, Julia Kiraly, Walter Nonneman, Vladimira Papirnik, Luc Popelier, Theodoros Roussis, Matthieu Vanhove, Christine Van Rijsseghem, Marc Wittemans,
76	KBC ANCORA	Francky Depickere, Katelijn Callewaert, Jean-Francois Dister, Koen Kerremans, Johan Massy, Henri Vandermeulen, Herman Vandaele, Danielle Sougne, Jules Stuyck,
77	KEYWARE	Guido Van der Schueren, Stephane Vandervelde, Chris Buyse, Bruno Kusters, Pierre Delhaize, Johan Bohets,
78	KIADIS	Mark Wegter, Berndt Modig, Stuart Chapman, Martijn Kleijwegt, Robert Soiffer,
79	KINEPOLIS	Philip Ghekiere, Joost Bert, Eddy Duquenne, Rafael Decaluwe, Marion Debruyne, Geert Vanderstappen, Annelies van Zutphen, Jo Van Biesbroeck, Adrienne Axler,

80	KKO INTERNATIONAL	Jacques -Antoine de Geffrier, Remy Allemane, Huques Lamotte, Robert Osselaer, Pierre Moncheur,
81	LEASINVEST	Michel Eeckhout, Eric Van Dyck, Mark Leysen, Jean-Louis Appelmans, Michel Van Geyte, Jan Suykens, Piet Dejonghe, Guy Van Wymersch-Moons, Sonja Rottiers,
82	LOTUS BAKERIES	Jan Vander Stichele, Jan Boone, Johan Boone, Anton Stevens, Benedikte Boone, Sofie Boone, Herman Van de Velde, Benoit Graulich, Dominique Leroy, Sabine Sagaert,
83	MDXHEALTH	Jan Groen, Rudi Marien, Ruth Devenyns, Jan Pensaert, Walter Narajowski, Mark Shaffar,
84	MELEXIS	Roland Duchatelet, Francoise Chombar, Rudi Dewinter, Shiro Baba, Martine Baelmans, Jenny Claes,
85	MIKO	Frans Michielsen, Frans Van Tilborg, Kristof Michielsen, Karl Hermans, Patrick Michielsen, Bart Wauters, Flor Joosen, Chris Van Doorslaer, Mark Stulens, Sabine Sagaert, Cynthia Van Hulle,
86	MITHRA	Marc Coucke, Francois Fornieri, Philippe Suinen, Jacques Platieau, Koen Hoffman, Marc Beyens, Guy Debruyne, Gaetan Servais, Freya Loncin, Jean-Michel Foidart, Christiane Malcorps, Eric Van Traelen,
87	MONTEA	Dirk De Pauw, Ciska Servais, Jo De Wolf, Peter Snoeck, Andre Bosmans, Jean-Marc Mayeur, Dirk Vanderschrick, Sophie Maes, Michel Delbaere,
88	MOURY CONSTRUCT	Gilles-Olivier Moury, Georges Moury, Jean Pierre Barbarin, Francy Lemmens, Michel Mikolajczak, Maurice Semer,
89	NYRSTAR	Martyn Konig, Jesus Fernandez, Anne Fahy, Carole Cable, Christopher Cox, Hilmar Rode, Karel Vinck, Julien De Wilde,
90	OIM	Peter Zwart, Arnoud van Raak, Wytse Bouma, Thomas Ackerly, Michael Hartung, Reinhard Krafft,
91	ONTEX	Inge Boets, Luc Missorten, Gunnar Johansson, Uwe Kruger, Charles Bouaziz, Jacques Purnode, Thierry Navarre, Juan Gilberto Marin Quintero,
92	OPTION	Jan Callewaert, Raju Dandu, Dimitri Duffeleer, Sabine Everaet, Frank Deschuytere, Francis Vanderhoydonck, Jurgen Ingels, Jan Vostermans, Jorg Palm, Steve Theunissen, Christine Pollie,
93	OPTION TRADING CO	Maurizio Scrocca, Marcel Dekkers,
94	ORANGE BE	Jan Steyaert, Michael Trabbia, Johan Deschuyffeleer, Christophe Naulleau, Beatrice Mandine, Nadine Lemaitre, Patrice Lambert de Diesbach, Gervais Pellissier, Jerome Barre, Gregoire Dallemagne, Martine De Rouck, Francis Gelibter,
95	PCB	Alain Charlier, Veronique Delens, Pascal Montgieux, Thomas Frings, Philippe Lacroix, Jean-Marie Limpens, Luc Meurrens, Markus Skripek,
96	PICANOL	Stefaan Haspeslagh, Hugo Vandamme, Luc Van Nevel, Jean Pierre Dejaeghere, Patrick Steverlynck, Luc Tack,
97	PROXIMUS	Dominique Leroy, Stefaan De Clerck, Karel De Gucht, Pierre Demuelenaere, Guido Demuynck, Martin De Prycker, Martine Durez, Laurent Levaux, Tanuja Randery, Isabelle Santens, Agnes Touraine, Catherine Vandenborre, Luc Van den Hove, Paul Van de Perre,
98	QRF	Inge Boets, Jan Brouwers, Frank De Moor, Anneleen Desmyter, Freddy Hoorens, Herman Du Bois,

99	QUEST for GROWTH	Antoon De Proft, Rene Avonts, Philippe de Vicq de Cumptich, Jos Peeters, Bernard De Gerlache De Gomery, Lieve Verplancke, Philippe Haspeslagh, Rudi Marien, Michel Akkermans, Regine Slagmulder, Bart Fransis,
100	REALDOLMEN	Thierry Janssen, Jef Colruyt, Wim Colruyt, Gaetan Hannecart, Inge Buyse, Lieve Mostrey, Nadia Verwilghen,
101	RECTICEL	Johnny Thijs, Olivier Chapelle, Marion Debruyne, Benoit Deckers, Pierre-Yves Laminne, Ingrid Merckx, Luc Missorten, Kurt Pierloot, Patrick Van Craen, Wilfried Vandepoel, Frederic van Gansberghe, Jacqueline Zoete,
102	RESILUX	Alex De Cuyper, Dirk De Cuyper, Peter De Cuyper, Francis Vanderhoydonck, Dirk Lannoo, Guido Vanherpe, Chris Van Doorslaer,
103	RETAIL EST	Paul Borghgraef, Jan De Nys, Kara De Smet, Jean-Louis Appelmans, Victor Ragoen, Jean Sterbelle, Christophe Demain, Rudy De Smedt, Rene Annaert, Leen Van den Neste, Herlinde Wouters,
104	ROSIER	Willy Raymaekers, Simon Jones, Thierry Kuter, Benoit Taymans, Daniel Richir, Nicolas David, Laurent Verhelst,
105	ROULARTA	Carel Bikkers, Xavier Bouckaert, Joris Claeys, Lieve Claeys, Koen Dejonckheere, Caroline De Nolf, Francis De Nolf, Rik De Nolf, Marc Verhamme,
106	RTL GROUP	Anke Schaferkordt, Guillaume De Posch, Elmar Heggen, Thomas Rabbe, Martin Taylor, Thomas Gotz, Rolf Hellermann, Bernd Hirsch, Bernd Kundrun, Jacques Santer, Rolf Schmidt-Holtz, James Singh,
107	SABCA	Remo Pellichero, Charles Edelstenne, Hans Buthker, Loik Segalen, N Waters, Benoit Berger, Jacques de Smet, Olivier Costa de Beauregard, Philippe Delaunois, M Martin,
108	SAINT GOBAIN	Pierre-Andre De Chalendar, Alain Destrain, Jean-Martin Folz, Bernard Gautier, Ieda Gomes Yell, Anne-Marie Idrac, Pamela Knapp, Pascal Lai, Agnes Lemarchand, Frederic Lemoine, Jacques Pestre, Olivia Qiu, Denis Ranque, Gilles Schnepp, Jean-Dominique Senard, Philippe Varin,
109	SAPEC	Eduardo de Almeida Catroga, Philippe de Borgia de Broqueville, Sophie de Roux, Xavier de Walque, Matthieu Delouvrier, Jean-Marie Josi, Antoine Velge, Patricia Velge,
110	SKV	Johan Deschrijver, Andreas De Schryver, Nele Bockaert, Luc Dauwe, Jacques De Schryver, Jan Peeters, Klara Storme, Geert Van Cauwelaert, Luc Vansteenkiste, Walter Verhaert,
111	SIOEN	Michel Delbaere, Michele Sioen, Jacqueline Zoete, Danielle Parein-Sioen, P Sioen, Luc Vandewalle, Jules Noten, Pierre Macharis, Dirk Meeus,
112	SIPEF	Luc Bertrand, Francois Van Hoydonck, Priscilla Bracht, Jacques Delen, Bryan Dyer, Antoine Friling, Regnier Haegelsteen, Sophie Lammerant - Velge, Antoine de Spoelberch,
113	SMARTPHOTO GROUP	Tonny Van Doorslaer, Stef De corte, Philippe Vlerick, Luc Vansteenkiste, Patrick De Greve, Geert Vanderstappen, Norbert Verkimpe, Katrien Mattelaer, Katya Degrieck,
114	SSPDE	Anne Charlotte Amory, Jean Vandemoortele, Marc DuBois, Axel Miller, Jean van de Moortele, Didier De Sorgher,
115	SCB	Marcel Asselberghs, Francois Monfils, Baudouin Van der Kelen, Frederic Van der Kelen, Anne Van der Kelen, Isabelle Van der Kelen, Jean Wellens,

116	SOFINA	David Verey, Dominique Lancksweert, Harold Boel, Jacques Emsens, Robert Peugeot, Helene Ploix, Analjit Singh, Michel Tilmant, Guy Verhofstadt, Hanneke Smits, Laurent de Meeus d'Argenteuil, Richard Goblet, Etienne Davignon,
117	SOLVAC	Jean-Pierre Delwart, Bernard de Laguiche, Bruno Rolin, Patrick Solvay, Francois-Xavier de Dorlodot, Yvonne Boel, John Kraft de la Saulx, Aude Thibaut de Maisieres, Alain Semet, Jean-Patrick Mondron, Marc-Eric Janssen, Laure le Hardy de Beaulieu, Guy de Selliers de Moranville,
118	SOLVAY	Nicolas Boel, Jean-Pierre Clamadieu, Bernard de Laguiche, Jean-Marie Solvay, Marjan Oudeman, Denis Solvay, Bernhard Scheuble, Charles Casimir-Lambert, Herve Coppens d'Eeckenbrugge, Yves-Thibault de Silguy, Evelyn du Monceau, Francoise de Viron, Amparo Moraleda, Rosemary Thorne, Gilles Michel,
119	SPADEL	Marc du Bois, Axel Miller, Roland Vaxeleire, Anne Charlotte Amory, Frank Meysman, Johnny Thijs, Jean Vandemoortele,
120	SUCRAF	Peter-Paul de Vries, Gerben Hettinga, Bettekee Koopmans, Guido Wallebroek,
121	SUEZ	Gerard Mestrallet, Jean-Louis Chaussade, Nicolas Bazire, Gilles Benoist, Valerie Bernis, Miriem Bensalah Chaqroun, Isidro Faine Casas, Lorenz d'Este, Delphine Ernotte Cunci, Pierre Mongin, Judith Hartmann, Isabelle Kocher, Ines Kolmsee, Anne Lauvergeon, Guillaume Peppy, Jerome Tolot, Agatta Constantini, Enric Amiguet Rovira, Guillaume Thivolle,
122	TELENET	Bert De Graeve, Jo Van Biesbroeck, Christine Franck, John Porter, Charles Bracken, Diederik Karsten, Manuel Kohnstamm, Jim Ryan, Suzanne Schoettger, Dana Strong, Andre Sarens,
123	TER BEKE	Louis-Henri Verbeke, Ann Vereecke, Thierry Balot, Ann Coopman, Dominique Coopman, Dirk Goeminne, Guido Vanherpe, Jules Noten, Eddy Van Der Pluym, Dirk de Backer,
124	TESSENDERLO	Stefaan Haspeslagh, Luc Tack, Karel Vinck, Veronique Bolland, Philippe Coens, Dominique Zakovitch-Damon,
125	TEXAF	Dominique Moorkens, Herman De Croo, Vincent Bribosia, Philippe Croonenberghs, Christophe Evers, Michel Gallez, Pascale Tytgat, Jean-Philippe Waterschoot, Albert Yuma Malumbi,
126	THROMBOGENICS	Staf Van Reet, Patrik De Haes, Thomas Clay, Luc Philips, Patrcia Ceysens, David Guyer, Paul Howes, Emmanuele Attout, Philippe Vlerick,
127	TIGENIX	Jean Stephenne, Eduardo Bravo, Willy Duron, Russell Greig, June Almenoff,
128	TINC INVEST	Jean-Pierre Blumberg, Els Blaton, Jean Pierre Dejaeghere, Marc Vercruysse, Peter Vermeiren, Bart Fransis,
129	TOTAL	Patrick Pouyanne, Patrick Artus, Patricia Barbizet, Marc Blanc, Marie-Christine Coisne-Roquette, Paul Desmarais, Maria van der Hoeven, Anne-Marie Idrac, Barbara Kux, Gerard Lamarche, Jean Lemierre, Renata Perycz,
130	TUBIZE FIN	Francois Tesch, Karel Boone, Arnoud de Pret, Cyril Janssen, Charles-Antoine Janssen, Nicolas Janssen, Evelyn du Monceau, Fiona de Hemptinne, Cedric van Rijckevorsel, Cynthia Favre d'Echallens,

131	UCB	Gerhard Mayr, Evelyn du Monceau, Jean-Christophe Tellier, Alice Dautry, Kay Davies, Bert De Graeve, Harriet Edelman, Pierre Gurdjian, Charles-Antoine Janssen, Cyril Janssen, Norman Ornstein, Cedric van Rijckevorsel, Ulf Wiinberg,
132	UMICORE	Thomas Leysen, Marc Grynberg, Ines Kolmsee, Barbara Kux, Rudi Thomaes, Eric Meurice, Mark Garrett, Francoise Chombar, Jonathan Oppenheimer, Ian Gallienne, Colin Hall, Karel Vinck,
133	VAN DE VELDE	Benoit Graulich, Dirk Goeminne, Yvan Jansen, Herman Van de Velde, Lucas Laureys, Benedicte Laureys, Marleen Vaesen, Henri-William Van de Velde, Ignace Van Doorselaere,
134	VASTNED BE	Jean-Pierre Blumberg, Taco de Groot, Thomas de Witte, Peggy Deraedt, Chris Peeters, Anka Reijnen, Hubert Roovers, Nick van Ommen, Reinier Walta,
135	VGP	Marek Sebestak, Jan Van Geet, Alexander Saverys, Jos Thys,
136	VIOHALCO	Nicholaos Stassinopoulos, Evangelos Moustakas, Jacques Moulaert, Michail Stassinopoulos, Ioannis Stannisopoulos, Jean-Charles Faulx, Xavier Bedoret, Efthimios Christodoulou, Jean-Jacques de Launoit, Jean-Pierre de Launoit, Francis Mer, Rudolf Wiedenmann,
137	WAREHOUSES DE PAUW	Mark Duyck, Tony De Pauw, Anne Leclercq, Frank Meysman, Joost Uwents, Cynthia Van Hulle,
138	WAREHOUSES ESTATES	Christian Jacqmin, Claude Bolette, Claude Desseille, Robert Wagner, Caroline Wagner, Valerie Wagner, Daniel Weekers,
139	WERELDHAVE BE	Dirk Goeminne, Philippe Naert, Jacques de Smet, Dirk Anbeek, Kasper Deforche,
140	XIOR	Leen Van den Neste, Joost Uwents, Wilfried Neven, Wouter De Maeseneire, Christian Teunissen, Frederik Snauwaert,
141	ZENITEL	Peter Van de Weyer, Eugeen Beckers, Kenneth Dastol, Hans Swinnen, Jo Van Gorp, Wenche Holen, Liesbet Van der Perre,
142	ZETES IND	Jean-Francois Jacques, Hiram Claus, Sophie De Roux, Floris Vansina, Michel Alle, Olivier Gernay, Pierre Louis Lambert, Jean-Marie Josi, Jacques Lefevre, Marianne Merchez, Jose Zurstrassen,

Appendix 4.1 Company data (2011)

Table 26: Overview of company data (2011)

	Company Name	*Market Value of Equity (Mio. €)*	*Book Value of Assets (Mio. €)*	*Tobin's Q*	*Leverage*	*Return on Assets*
1	4ENERGY INV	16.15	89.96	0.93	0.75	-4.72%
2	AB INBEV	75,060.70	69,659.98	1.36	0.28	35.39%
3	ABLYNX	155.93	191.48	1.05	0.24	-22.92%
4	ACCENTIS	25.35	86.39	0.67	0.38	-29.72%
5	ACKERMANS VHAAREN	1,924.03	2,426.18	1.79	1.00	39.10%
6	AEDIFICA	311.43	530.87	1.07	0.48	4.77%
7	AGEAS	3,053.21	5,054.00	0.89	0.28	5.82%
8	AGFA GEVAERT	211.37	2,949.00	0.73	0.66	-2.41%
9	ALFACAM GROUP	-	-	-	-	-
10	ARCELORMITTAL	72,490.11	141,194.63	0.78	0.26	6.42%
11	ARSEUS	326.23	495.02	0.99	0.33	2.95%
12	ARTHUR	-	-	-	-	-
13	ASCENCIO	182.86	344.36	0.98	0.45	2.92%
14	ATENOR GROUP	122.89	278.41	1.09	0.65	4.07%
15	BANIMMO	115.50	376.26	0.95	0.64	0.31%
16	BARCO	500.63	1,033.48	1.10	0.61	6.20%
17	BEFIMMO	926.77	1,943.92	0.94	0.47	3.27%
18	BEKAERT	1,617.56	2,297.99	1.40	0.70	11.14%
19	BELGACOM	8,176.83	8,312.00	1.59	0.60	9.30%
20	BELRECA	24.11	24.49	1.02	0.03	-0.27%
21	BELUGA	3.42	7.36	0.65	0.18	-1.30%
22	BQUE NAT BELGIQUE	-	-	-	-	-
23	BREDERODE	552.10	481.22	1.23	0.08	0.00%
24	CAMPINE	26.97	80.83	1.00	0.66	5.01%
25	CFE	507.06	622.51	1.55	0.74	5.16%
26	CIE BOIS SAUVAGE	290.32	551.98	0.83	0.30	6.28%
27	CIMESCAUT	64.40	65.03	1.28	0.29	5.29%
28	CMB	601.41	1,590.73	1.03	0.65	-0.58%
29	COFINIMMO	1,375.64	3,329.78	0.95	0.53	3.33%
30	COLRUYT	4,677.97	3,167.00	1.97	0.49	10.43%

31	CONNECT GROUP	15.85	80.98	0.91	0.71	4.61%
32	D'IETEREN	1,879.22	3,650.30	1.10	0.58	10.33%
33	DECEUNINCK	81.89	443.70	0.72	0.54	1.42%
34	DEFICOM GROUP	43.31	99.61	0.80	0.37	2.46%
35	DELHAIZE GROUP	4,370.69	16,368.00	0.83	0.56	3.84%
36	DEVGEN	-	-	-	-	-
37	DEXIA	578.85	9,482.80	0.77	0.71	-173.02%
38	DUVEL MOORTGAT	-	-	0.47	-	-
39	ECONOCOM GROUP	396.78	565.20	1.36	0.66	20.95%
40	ELIA	1,808.85	5,843.80	0.96	0.65	2.35%
41	EURONAV	191.50	2,239.60	0.59	0.51	-6.10%
42	EVS BROADCEQUIPM	532.60	95.40	6.18	0.59	38.25%
43	EXMAR	335.88	1,264.90	0.81	0.54	4.83%
44	FLORIDIENNE	124.34	299.15	1.00	0.58	12.48%
45	FLUXYS	1,984.24	2,800.21	1.39	0.68	5.61%
46	FOUNTAIN	21.07	57.00	0.66	0.29	-4.65%
47	GALAPAGOS	274.59	248.02	1.61	0.51	-13.10%
48	GBL	8,418.06	18,149.90	0.77	0.30	0.41%
49	GDF SUEZ	47,818.78	213,410.00	0.85	0.62	2.54%
50	GIMV	852.88	1,055.19	0.84	0.03	-2.25%
51	GLOBAL GRAPHICS	9.98	17.40	0.68	0.11	0.88%
52	HAMON	108.88	400.70	1.05	0.78	1.00%
53	HENEX	565.66	787.75	0.72	0.00	0.10%
54	HOME INVBELG SIFI	206.91	268.51	1.11	0.34	5.59%
55	IRIS GROUP	-	-	-	-	-
56	IBA	187.79	498.01	1.24	0.86	-16.89%
57	IBT	-	-	-	-	-
58	IMMO MOURY	28.05	25.28	1.19	0.08	2.27%
59	IMMOBEL	100.53	313.66	0.74	0.41	6.03%
60	ING GROEP	21,564.46	169,149.09	1.07	0.94	0.51%
61	INTERVRETAIL	228.43	364.22	1.00	0.37	9.97%
62	INTERVEST OFFICES	252.42	594.13	0.95	0.52	3.03%
63	JENSEN GROUP	60.42	151.89	1.00	0.60	3.02%
64	KBC	3,295.81	15,885.00	0.52	0.32	0.29%
65	KBC ANCORA	383.68	2,589.82	0.39	0.24	-1.17%
66	KEYWARE TECH	12.08	20.55	1.03	0.44	0.40%
67	KINEPOLIS GROUP	363.03	326.95	1.70	0.59	11.15%

68	LEASINVEST	259.51	483.15	1.14	0.60	0.77%
69	LOTUS BAKERIES	311.62	237.89	1.78	0.47	10.01%
70	MDXHEALTH	27.93	14.69	2.13	0.23	-47.27%
71	MEDIVISION	-	-	-	-	-
72	MELEXIS	418.95	178.10	2.75	0.40	25.77%
73	MIKO	56.54	96.49	0.99	0.40	5.78%
74	MOBISTAR	2,422.78	1,381.50	2.47	0.72	16.00%
75	MONTEA CVA	138.15	269.48	1.08	0.57	-0.11%
76	MOPOLI	-	-	-	-	-
77	MOURY CONSTRUCT	44.99	75.75	1.03	0.44	1.46%
78	NAT PORTEFEUIL	-	-	-	-	-
79	NEUFCOUR FIN	2.79	7.46	0.72	0.35	0.91%
80	NYRSTAR	1,037.14	3,068.44	0.64	0.30	1.52%
81	OIM	19.44	20.89	1.46	0.53	13.03%
82	OMEGA PHARMA	-	-	0.58	-	-
83	OPTION	24.75	42.85	1.37	0.79	11.95%
84	PARC PARADISIO	-	-	-	-	-
85	PAYTON PLANAR	16.43	31.30	0.63	0.11	8.70%
86	PCB	19.31	122.51	1.00	0.84	2.24%
87	PICANOL	180.36	288.26	1.06	0.44	22.16%
88	PINGUINLUTOSA	331.02	678.85	1.24	0.75	-2.07%
89	PUNCH INT	-	-	-	-	-
90	QUESTFOR GR	54.77	91.22	0.60	0.00	-14.59%
91	REALDOLM	89.97	266.68	0.80	0.46	2.73%
92	RECTICEL	131.93	728.12	0.84	0.66	2.39%
93	RENTABILIWEB	108.02	102.46	1.36	0.30	10.32%
94	RESILUX	101.97	177.48	1.17	0.59	4.50%
95	RETAIL EST	267.56	554.94	1.05	0.57	1.54%
96	RHJ INTERNATIONAL	-	-	-	-	-
97	ROSIER	-	-	-	-	-
98	ROULARTA	191.86	609.04	0.78	0.47	1.91%
99	RTL GROUP	11,598.23	7,629.00	1.85	0.33	10.42%
100	SABCA	55.92	350.83	0.88	0.72	3.52%
101	SAINT GOBAIN	15,612.52	46,234.00	0.94	0.61	2.94%
102	SAPEC	57.59	366.59	0.84	0.69	1.28%
103	SCHEERDV KERCHOVE	17.36	50.91	0.78	0.44	-1.17%
104	SERVICEFLATS	-	-	-	-	-

105	SIOEN	110.81	348.47	0.89	0.57	3.33%
106	SIPEF	519.20	756.39	1.69	1.00	17.90%
107	SOFINA	3,489.09	1,761.00	2.22	0.24	7.95%
108	SOLVAC	1,253.49	2,224.24	0.64	0.07	3.27%
109	SOLVAY	5,395.45	19,462.00	0.94	0.66	1.24%
110	SPADEL	222.67	131.12	2.02	0.32	10.07%
111	SPECTOR	13.92	130.71	0.11	0.01	-1.09%
112	SUCRAF	1.60	1.68	1.92	0.97	-21.71%
113	SUEZ	-	-	-	-	-
114	SYSTEMAT	-	-	-	-	-
115	TELENET	3,318.50	3,541.73	2.01	1.07	0.47%
116	TER BEKE	89.30	183.80	1.06	0.58	1.79%
117	TESSENDERLO	630.49	1,379.70	1.02	0.56	-7.83%
118	TEXAF	53.58	97.67	1.00	0.45	1.87%
119	THENERGO	9.37	21.46	1.45	1.01	-58.21%
120	THINK MEDIA	-	-	-	-	-
121	THROMBOGENICS	611.95	129.09	4.83	0.09	-16.76%
122	TIGENIX	70.20	75.32	1.11	0.18	-49.53%
123	TOTAL	89,149.58	164,049.00	1.12	0.58	7.67%
124	TRANSICS	-	-	-	-	-
125	TUBIZE FIN	1,083.55	1,824.40	0.77	0.18	3.61%
126	UCB	5,803.04	9,176.00	1.12	0.49	2.47%
127	UMICORE	3,648.12	5,073.15	1.44	0.72	3.08%
128	UNIBRA	-	-	-	-	-
129	VAN DE VELDE	471.83	139.50	3.77	0.39	12.60%
130	VGP	352.89	177.89	2.11	0.13	7.27%
131	VPK PACKAGING	-	-	-	-	-
132	VRANKEN POMMERY	176.21	1,127.63	0.88	0.73	0.79%
133	WAREHOUSES SICAFI	139.16	165.97	1.09	0.25	6.53%
134	WDP	514.72	1,018.88	1.11	0.61	2.92%
135	WERELDHAVE BELGIUM	356.71	496.42	0.92	0.20	7.72%
136	ZENITEL	5.43	41.22	0.99	0.86	1.33%
137	ZETES INDUSTRIES	85.08	163.52	1.04	0.52	3.82%

Entries '-' indicate missing data

Appendix 4.2 Company data (2016)

Table 27: Overview of company data (2016)

	Company Name	*Market Value of Equity (Mio. €)*	*Book Value of Assets (Mio. €)*	*Tobin's Q*	*Leverage*	*Return on Assets*
1	4Energy Invest	24.30	24.62	1.04	0.06	62.94%
2	AB INBEV	167,717.40	192,987.00	1.50	0.63	1.95%
3	ABLYNX	872.06	266.76	3.88	0.61	-0.41%
4	ABO GROUP	20.72	28.36	0.81	0.08	0.69%
5	ACCENTIS	50.71	79.42	0.85	0.21	1.00%
6	ACKERMANS&VAN HAAREN	4,424.95	2,537.05	2.08	0.34	12.71%
7	AEDIFICA	1,031.52	1,120.54	1.37	0.45	3.60%
8	AGEAS	9,223.40	8,132.00	1.36	0.22	-1.66%
9	AGFA	615.65	2,402.00	1.14	0.89	2.96%
10	AHOLD DELHAIZE	20,650.93	10,199.00	2.47	0.45	8.35%
11	APERAM	3,392.83	4,675.00	1.19	0.47	4.58%
12	ARGENX	-	-	-	-	-
13	ASCENCIO	391.80	567.58	1.13	0.44	7.09%
14	ASIT	89.94	20.61	4.46	0.10	-77.64%
15	ATENOR	264.66	534.30	1.29	0.79	1.18%
16	AVANTIUM	279.29	79.58	3.92	0.41	47.92%
17	BANIMMO	80.29	144.74	1.33	0.78	-37.68%
18	BANQUE NAT BELGE	-	-	-	-	-
19	BARCO	1,045.08	1,159.23	1.37	0.47	2.21%
20	BEFIMMO	1,285.85	2,567.71	0.96	0.45	3.52%
21	BEKAERT	2,322.79	4,304.31	1.17	0.63	3.33%
22	BELRECA	32.81	35.31	0.95	0.02	3.04%
23	BELUGA	1.90	3.97	0.72	0.24	-7.11%
24	BIOCARTIS	457.20	403.61	1.17	0.04	-0.22%
25	BONE THERAPEUTICS	53.36	35.96	1.83	0.35	-46.62%
26	BPOST	4,500.02	1,780.80	3.11	0.58	17.33%
27	BREDERODE	1,223.80	1,705.92	0.72	0.00	10.06%
28	CAMPINE	16.95	67.48	0.97	0.72	-5.65%
29	CARE PROPERTY INVEST	304.27	250.92	1.79	0.57	3.27%
30	CELYAD	169.57	138.81	1.57	0.35	-16.88%
31	CENERGY	-	-	-	-	-
32	CFE	2,618.78	4,328.22	0.61	0.00	3.89%

33	CIE BOIS SAUVAGE	515.50	503.91	1.36	0.33	4.07%
34	COFINIMMO	2,210.56	3,510.78	1.10	0.47	1.10%
35	COLRUYT	7,676.72	4,019.20	2.40	0.49	9.11%
36	CONNECT GROUP	4.01	80.00	0.87	0.82	-10.85%
37	CURETIS	155.07	57.40	2.75	0.05	-6.32%
38	D'IETEREN	2,282.45	3,831.60	1.16	0.56	1.35%
39	DALENYS	159.88	86.99	1.85	0.01	-0.69%
40	DECEUNINCK	328.98	360.73	1.35	0.43	0.95%
41	DELTA LLOYD	1,877.62	73,468.20	0.99	0.96	0.19%
42	DEXIA	355.31	3,123.43	0.16	0.04	8.37%
43	ECKERT ZIEGLER	24.47	48.24	0.71	0.20	-8.70%
44	ECONOCOM	962.04	722.48	1.93	0.60	4.63%
45	ELIA	3,009.92	5,497.70	1.24	0.69	2.28%
46	EMAKINA	54.50	44.82	1.98	0.76	2.57%
47	ENGIE	27,379.59	158,499.00	0.89	0.71	3.89%
48	ENVIPCO	8.89	32.74	0.73	0.46	7.98%
49	EURONAV	1,199.63	3,046.91	0.77	0.38	6.70%
50	EURONEXT	-	-	-	-	-
51	EVS	456.30	153.53	3.41	0.44	18.59%
52	EXMAR	437.55	891.27	0.89	0.40	-0.40%
53	FAGRON	523.92	856.63	1.02	0.41	0.73%
54	FLORIDIENNE	96.70	242.90	1.00	0.61	2.92%
55	FLUXYS	1,826.86	2,989.17	1.38	0.77	1.62%
56	FNG	-	-	-	-	-
57	FOUNTAIN	5.73	22.57	1.00	0.74	0.90%
58	GALAPAGOS	2,784.71	1,083.34	2.87	0.30	4.99%
59	GBL	12,386.42	21,872.80	0.89	0.32	-2.09%
60	GENKYOTEX	31.85	26.68	1.30	0.10	-41.96%
61	GIMV	1,178.80	1,230.33	0.99	0.03	11.15%
62	GLOBAL GRAPHICS	36.03	29.14	1.54	0.30	2.05%
63	GREENYARD	513.60	732.83	1.20	0.50	2.32%
64	HAMON	74.72	567.80	1.04	0.91	-0.95%
65	HOME INVEST	292.68	363.06	1.25	0.45	4.22%
66	IBA	986.71	769.45	2.14	0.86	3.04%
67	IEP INVEST	65.47	181.98	0.90	0.54	3.08%
68	IMMO BEAULIEU	-	-	-	-	-
69	IMMO LUX AIRPORT	-	-	-	-	-

70	IMMO MOURY	24.06	27.89	1.06	0.20	3.31%
71	IMMOBEL	580.95	444.47	1.86	0.56	4.51%
72	ING	746.99	150,418.72	0.94	0.93	0.38%
73	INTERVEST	401.16	625.09	1.12	0.48	3.29%
74	JENSEN GROUP	270.46	121.54	2.38	0.16	0.48%
75	KBC	24,111.83	252,356.00	1.03	0.93	0.00%
76	KBC ANCORA	2,295.00	2,441.80	1.10	0.16	-0.86%
77	KEYWARE	36.49	10.70	3.68	0.27	13.67%
78	KIADIS	116.23	29.22	4.66	0.68	-50.51%
79	KINEPOLIS	1,138.38	326.95	4.07	0.59	9.87%
80	KKO INTERNATIONAL	16.66	13.16	1.31	0.05	-22.56%
81	LEASINVEST	510.28	814.49	1.19	0.56	3.82%
82	LOTUS BAKERIES	1,982.87	548.00	4.16	0.55	11.40%
83	MDXHEALTH	186.03	57.74	3.46	0.23	-25.06%
84	MELEXIS	2,571.46	358.17	7.45	0.27	26.87%
85	MIKO	126.42	75.46	1.78	0.10	0.91%
86	MITHRA	279.24	172.70	2.08	0.46	-20.32%
87	MONTEA	461.47	594.76	1.35	0.58	5.80%
88	MOURY CONSTRUCT	53.24	90.15	1.59	1.00	4.33%
89	NYRSTAR	739.16	1,660.94	1.44	1.00	-17.16%
90	OIM	-	-	-	-	-
91	ONTEX	2,102.00	2,449.00	1.45	0.59	4.89%
92	OPTION	22.07	7.83	7.36	4.54	-179.85%
93	OPTION TRADING CO	1.45	1.64	0.89	0.00	1.95%
94	ORANGE BE	1,191.88	1,465.98	1.46	0.65	5.60%
95	PCB	33.58	107.06	1.10	0.79	2.46%
96	PICANOL	1,373.52	678.50	2.24	0.22	16.78%
97	PROXIMUS	8,826.61	8,117.00	1.72	0.63	6.75%
98	QRF	120.73	215.07	1.08	0.52	1.69%
99	QUEST for GROWTH	115.94	135.02	0.86	0.00	0.31%
100	REALDOLMEN	128.64	205.28	0.91	0.28	5.20%
101	RECTICEL	159.54	692.95	0.87	0.64	2.36%
102	RESILUX	310.86	159.96	2.42	0.48	17.34%
103	RETAIL EST	691.55	1,015.62	1.21	0.53	4.14%
104	ROSIER	47.18	76.25	1.14	0.53	-5.57%
105	ROULARTA	303.66	443.20	1.18	0.49	4.34%
106	RTL GROUP	10,625.29	8,217.00	1.86	0.57	9.93%

107	SABCA	69.79	338.60	0.97	0.76	-2.64%
108	SAINT GOBAIN	24,410.18	43,767.00	1.12	0.56	3.09%
109	SAPEC	40.65	375.05	0.86	0.75	-0.46%
110	SKV	-	-	-	-	-
111	SIOEN	555.13	368.41	1.99	0.49	7.05%
112	SIPEF	537.21	364.87	2.09	0.62	6.34%
113	SMARTPHOTO GROUP	62.28	52.07	1.26	0.06	-1.78%
114	SSPDE	-	-	-	-	-
115	SCB	-	-	-	-	-
116	SOFINA	4,212.76	1,794.00	2.49	0.14	9.75%
117	SOLVAC	2,479.50	3,444.00	0.78	0.06	5.52%
118	SOLVAY	11,789.29	19,489.00	1.05	0.45	2.07%
119	SPADEL	460.69	199.40	2.67	0.36	5.44%
120	SUCRAF	-	-	-	-	-
121	SUEZ	7,928.49	29,284.00	1.02	0.75	2.13%
122	TELENET	6,106.50	5,335.66	1.15	0.01	0.02%
123	TER BEKE	242.97	192.88	1.87	0.61	3.62%
124	TESSENDERLO	1,493.02	1,358.80	1.65	0.55	6.28%
125	TEXAF	116.59	59.99	2.05	0.11	0.91%
126	THROMBOGENICS	91.32	121.64	0.85	0.10	-49.61%
127	TIGENIX	125.89	163.91	0.97	0.21	-8.39%
128	TINC INVEST	133.24	134.86	1.03	0.04	6.93%
129	TOTAL	121,488.53	230,978.00	1.09	0.56	1.88%
130	TUBIZE FIN	3,030.67	2,222.82	1.48	0.12	8.15%
131	UCB	11,473.31	10,212.00	1.59	0.46	3.87%
132	UMICORE	5,920.06	4,145.75	1.98	0.55	3.41%
133	VAN DE VELDE	881.91	189.81	5.01	0.36	25.06%
134	VASTNED BE	273.50	352.86	1.06	0.29	5.82%
135	VGP	613.42	659.14	1.53	0.60	17.88%
136	VIOHALCO	417.30	3,626.21	0.80	0.68	-0.19%
137	WAREHOUSES DE PAUW	1,612.66	2,182.61	1.27	0.53	5.97%
138	WAREHOUSES ESTATES	204.21	231.73	1.24	0.36	8.63%
139	WERELDHAVE BE	747.33	3,507.85	0.65	0.44	2.87%
140	XIOR	175.71	273.56	1.16	0.52	1.88%
141	ZENITEL	39.67	43.39	1.04	0.12	0.83%
142	ZETES IND	279.45	199.10	1.93	0.53	5.76%

Entries '-' indicate missing data

Appendix 5.1 Company network characteristics (2011)

Table 28: Overview of company network characterisitics (2011)

	Company Name	*Number of Directors*	*Number of Female Directors*	*Percentage of Female Directors*	*Number of Busy Directors*	*Percentage of Busy Directors*	*Degree Centrality*	*Closeness Centrality*	*Betweenness Centrality*	*Eigenvector Centrality*
1	4ENERGY INVEST	6	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
2	AB INBEV	13	0	0.00%	1	7.69%	4.95%	27.56%	0.22%	12.55%
3	ABLYNX	7	0	0.00%	0	0.00%	0.99%	15.48%	0.00%	0.06%
4	ACCENTIS	5	0	0.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
5	ACKERMANS & VAN HAAREN	8	0	0.00%	1	12.50%	3.96%	24.16%	1.76%	2.33%
6	AEDIFICA	7	3	42.86%	0	0.00%	0.00%	0.00%	0.00%	0.00%
7	AGEAS	10	2	20.00%	0	0.00%	0.99%	20.10%	0.00%	1.11%
8	AGFA GEVAERT	9	0	0.00%	3	33.33%	7.92%	29.70%	7.15%	10.25%
9	ALFACAM GROUP	6	1	16.67%	1	16.67%	2.97%	19.75%	2.91%	0.31%
10	ARCELORMITTAL	9	1	11.11%	0	0.00%	0.00%	0.00%	0.00%	0.00%
11	ARSEUS	9	0	0.00%	2	22.22%	6.93%	29.81%	3.72%	11.74%
12	ARTHUR	3	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
13	ASCENCIO	8	1	12.50%	0	0.00%	0.99%	18.02%	0.00%	0.20%
14	ATENOR GROUP	7	0	0.00%	3	42.86%	7.92%	30.15%	8.35%	7.82%
15	BANIMMO	10	1	10.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
16	BARCO	10	1	10.00%	0	0.00%	3.96%	26.04%	3.75%	2.42%
17	BEFIMMO	8	0	0.00%	1	12.50%	2.97%	22.53%	1.76%	1.39%
18	BEKAERT	14	1	7.14%	0	0.00%	2.97%	23.94%	0.84%	5.01%
19	BELGACOM	14	5	35.71%	1	7.14%	4.95%	29.81%	2.39%	9.07%
20	BELRECA	4	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
21	BELUGA	7	0	0.00%	0	0.00%	0.99%	1.32%	0.00%	0.00%
22	BANQUE NAT BELGE	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
23	BREDERODE	7	0	0.00%	1	14.29%	2.97%	26.64%	3.49%	7.06%
24	CAMPINE	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
25	CFE	10	1	10.00%	0	0.00%	1.98%	22.78%	0.77%	0.91%
26	CIE BOIS SAUVAGE	9	1	11.11%	4	44.44%	9.90%	32.47%	5.69%	31.38%
27	CIMESCAUT	11	2	18.18%	0	0.00%	0.00%	0.00%	0.00%	0.00%
28	CMB	10	1	10.00%	3	30.00%	6.93%	28.54%	3.45%	16.85%
29	COFINIMMO	13	1	7.69%	2	15.38%	6.93%	27.19%	3.37%	16.80%
30	COLRUYT	5	0	0.00%	1	20.00%	3.96%	27.75%	1.45%	7.19%

31	CONNECT GROUP	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
32	D'IETEREN	13	1	7.69%	0	0.00%	3.96%	27.94%	1.68%	9.71%
33	DECEUNINCK	10	1	10.00%	1	10.00%	3.96%	27.85%	1.99%	4.90%
34	DEFICOM GROUP	10	1	10.00%	0	0.00%	0.99%	18.91%	0.00%	0.24%
35	DELHAIZE GROUP	12	0	0.00%	2	16.67%	6.93%	29.59%	1.87%	25.11%
36	DEVGEN	7	0	0.00%	0	0.00%	1.98%	18.69%	1.76%	0.41%
37	DEXIA	18	4	22.22%	2	11.11%	8.91%	31.21%	8.57%	15.52%
38	DUVEL MOORTGAT	6	1	16.67%	1	16.67%	1.98%	25.06%	0.00%	8.87%
39	ECONOCOM GROUP	8	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
40	ELIA	15	4	26.67%	2	13.33%	6.93%	28.34%	7.09%	5.09%
41	EURONAV	9	1	11.11%	1	11.11%	1.98%	24.68%	0.00%	4.24%
42	EVS	9	0	0.00%	0	0.00%	0.99%	18.23%	0.00%	0.59%
43	EXMAR	11	1	9.09%	4	36.36%	7.92%	31.45%	6.62%	12.05%
44	FLORIDIENNE	7	0	0.00%	2	28.57%	4.95%	25.70%	1.68%	3.48%
45	FLUXYS	18	6	33.33%	0	0.00%	0.99%	21.56%	0.00%	0.75%
46	FOUNTAIN	9	0	0.00%	1	11.11%	1.98%	22.85%	0.00%	1.61%
47	GALAPAGOS	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
48	GBL	16	0	0.00%	3	18.75%	5.94%	24.30%	1.92%	5.61%
49	GDF SUEZ	21	3	14.29%	4	19.05%	6.93%	26.73%	2.87%	7.70%
50	GIMV	12	4	33.33%	0	0.00%	0.99%	20.20%	0.00%	0.36%
51	GLOBAL GRAPHICS	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
52	HAMON	8	1	12.50%	1	12.50%	1.98%	24.16%	0.00%	2.28%
53	HENEX	7	0	0.00%	1	14.29%	1.98%	23.80%	0.00%	6.70%
54	HOME INVBELG SIFI	7	0	0.00%	1	14.29%	1.98%	22.22%	0.00%	3.33%
55	IRIS GROUP	7	0	0.00%	0	0.00%	0.99%	18.23%	0.00%	0.59%
56	IBA	9	1	11.11%	0	0.00%	0.99%	19.14%	0.00%	0.82%
57	IBT	10	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
58	IMMO MOURY	5	0	0.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
59	IMMOBEL	10	0	0.00%	0	0.00%	1.98%	23.94%	0.29%	2.07%
60	ING GROEP	3	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
61	INTERVRETAIL	6	0	0.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
62	INTERVEST OFFICES	7	0	0.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
63	JENSEN GROUP	6	0	0.00%	1	16.67%	2.97%	24.53%	4.43%	1.99%
64	KBC	23	1	4.35%	4	17.39%	11.88%	35.17%	15.95%	17.28%
65	KBC ANCORA	11	3	27.27%	1	9.09%	1.98%	25.62%	0.00%	3.11%
66	KEYWARE TECH	6	0	0.00%	0	0.00%	1.98%	1.98%	0.02%	0.00%

67	KINEPOLIS GROUP	8	2	25.00%	1	12.50%	2.97%	26.29%	2.03%	4.68%
68	LEASINVEST	11	0	0.00%	3	27.27%	8.91%	27.85%	6.67%	4.56%
69	LOTUS BAKERIES	11	0	0.00%	2	18.18%	7.92%	28.74%	2.62%	14.84%
70	MDXHEALTH	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
71	MEDIVISION	6	2	33.33%	0	0.00%	0.00%	0.00%	0.00%	0.00%
72	MELEXIS	6	3	50.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
73	MIKO	9	0	0.00%	1	11.11%	2.97%	26.47%	0.48%	3.90%
74	MOBISTAR	12	3	25.00%	0	0.00%	3.96%	23.94%	2.93%	1.66%
75	MONTEA	10	0	0.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
76	MOPOLI	4	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
77	MOURY CONSTRUCT	6	0	0.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
78	NAT PORTEFEUIL	12	2	16.67%	1	8.33%	3.96%	27.65%	2.87%	5.13%
79	NEUFCOUR FIN	6	1	16.67%	0	0.00%	0.00%	0.00%	0.00%	0.00%
80	NYRSTAR	6	0	0.00%	1	16.67%	2.97%	26.21%	0.00%	5.53%
81	OIM	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
82	OMEGA PHARMA	7	0	0.00%	1	14.29%	4.95%	26.47%	1.35%	6.19%
83	OPTION	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
84	PARC PARADISIO	11	0	0.00%	0	0.00%	2.97%	22.85%	3.50%	4.01%
85	PAYTON PLANAR	3	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
86	PCB	6	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
87	PICANOL	6	0	0.00%	2	33.33%	3.96%	17.43%	0.98%	0.08%
88	PINGUINLUTOSA	9	1	11.11%	2	22.22%	5.94%	28.74%	6.23%	8.14%
89	PUNCH INT	5	1	20.00%	0	0.00%	0.99%	0.99%	0.00%	0.00%
90	QUESTFOR GR	11	0	0.00%	1	9.09%	3.96%	23.45%	3.56%	2.71%
91	REALDOLM	8	0	0.00%	2	25.00%	4.95%	25.87%	2.22%	5.90%
92	RECTICEL	13	0	0.00%	6	46.15%	9.90%	31.57%	4.12%	33.15%
93	RENTABILIWEB	6	1	16.67%	0	0.00%	0.00%	0.00%	0.00%	0.00%
94	RESILUX	6	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
95	RETAIL EST	9	1	11.11%	0	0.00%	3.96%	30.73%	7.89%	5.61%
96	RHJ INTERNATIONAL	9	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
97	ROSIER	8	1	12.50%	0	0.00%	0.00%	0.00%	0.00%	0.00%
98	ROULARTA	8	3	37.50%	1	12.50%	1.98%	16.67%	0.00%	0.06%
99	RTL GROUP	8	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
100	SABCA	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
101	SAINT GOBAIN	15	2	13.33%	3	20.00%	6.93%	27.47%	3.25%	11.26%
102	SAPEC	9	1	11.11%	1	11.11%	2.97%	24.68%	0.78%	2.33%

103	SVK	9	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
104	SERVICEFLATS	9	1	11.11%	0	0.00%	1.98%	23.59%	3.89%	0.84%
105	SIOEN	9	4	44.44%	4	44.44%	9.90%	31.33%	5.84%	27.34%
106	SIPEF	8	1	12.50%	3	37.50%	5.94%	24.83%	0.72%	3.15%
107	SOFINA	10	0	0.00%	2	20.00%	7.92%	28.14%	3.35%	20.62%
108	SOLVAC	12	2	16.67%	0	0.00%	0.99%	20.10%	0.00%	1.11%
109	SOLVAY	16	2	12.50%	1	6.25%	5.94%	25.87%	4.56%	7.58%
110	SPADEL	7	0	0.00%	1	14.29%	1.98%	16.37%	0.00%	0.03%
111	SPECTOR	9	0	0.00%	2	22.22%	7.92%	32.60%	5.93%	25.97%
112	SUCRAF	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
113	SUEZ	18	2	11.11%	1	5.56%	4.95%	26.38%	1.19%	8.91%
114	SYSTEMAT	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
115	TELENET	19	1	5.26%	3	15.79%	8.91%	33.00%	7.67%	15.71%
116	TER BEKE	11	0	0.00%	3	27.27%	8.91%	30.15%	7.13%	26.16%
117	TESSENDERLO	13	0	0.00%	0	0.00%	1.98%	20.67%	1.76%	1.06%
118	TEXAF	4	0	0.00%	1	25.00%	2.97%	22.15%	0.00%	1.65%
119	THENERGO	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
120	THINK MEDIA	7	1	14.29%	0	0.00%	0.99%	1.32%	0.00%	0.00%
121	THROMBOGENICS	7	0	0.00%	1	14.29%	4.95%	29.81%	1.20%	12.80%
122	TIGENIX	6	0	0.00%	0	0.00%	1.98%	22.53%	0.00%	1.90%
123	TOTAL	14	2	14.29%	2	14.29%	3.96%	23.94%	0.06%	4.36%
124	TRANSICS	7	1	14.29%	1	14.29%	2.97%	26.12%	0.00%	6.92%
125	TUBIZE FIN	5	1	20.00%	1	20.00%	1.98%	25.06%	1.61%	2.26%
126	UCB	15	2	13.33%	2	13.33%	6.93%	26.56%	2.25%	15.32%
127	UMICORE	10	1	10.00%	4	40.00%	9.90%	31.21%	4.68%	27.03%
128	UNIBRA	7	2	28.57%	0	0.00%	0.99%	16.81%	0.00%	0.16%
129	VAN DE VELDE	7	1	14.29%	1	14.29%	3.96%	25.62%	0.79%	7.53%
130	VGP	5	0	0.00%	0	0.00%	0.99%	21.68%	0.00%	2.47%
131	VPK PACKAGING	8	0	0.00%	0	0.00%	0.99%	19.05%	0.00%	0.34%
132	VRANKEN POMMERY	11	1	9.09%	0	0.00%	0.00%	0.00%	0.00%	0.00%
133	WAREHOUSES SICAFI	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
134	WAREHOUSES DEPAUW	6	0	0.00%	1	16.67%	2.97%	19.23%	2.44%	0.14%
135	WERELDHAVE	4	0	0.00%	1	25.00%	2.97%	23.59%	0.00%	4.19%
136	ZENITEL	6	0	0.00%	1	16.67%	3.96%	29.27%	2.16%	6.35%
137	ZETES INDUSTRIES	9	0	0.00%	1	11.11%	1.98%	22.28%	0.00%	1.09%

Appendix 5.2 Company network characteristics (2016)

Table 29: Overview of company network characteristics (2016)

	Company Name	*Number of Directors*	*Number of Female Directors*	*Percentage of Female Directors*	*Number of Busy Directors*	*Percentage of Busy Directors*	*Degree Centrality*	*Closeness Centrality*	*Betweenness Centrality*	*Eigenvector Centrality*
1	4Energy Invest	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
2	AB INBEV	15	2	13.33%	0	0.00%	0.91%	18.48%	0.00%	1.63%
3	ABLYNX	8	2	25.00%	0	0.00%	1.82%	16.71%	1.65%	0.49%
4	ABO GROUP	4	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
5	ACCENTIS	5	2	40.00%	1	20.00%	2.73%	23.37%	0.29%	9.19%
6	ACKERMANS & VAN HAAREN	10	3	30.00%	2	20.00%	5.45%	25.11%	2.14%	15.75%
7	AEDIFICA	9	4	44.44%	0	0.00%	0.91%	18.15%	0.00%	1.15%
8	AGEAS	13	3	23.08%	0	0.00%	1.82%	21.65%	2.76%	4.20%
9	AGFA	8	2	25.00%	1	12.50%	5.45%	25.83%	7.81%	16.37%
10	AHOLD DELHAIZE	14	3	21.43%	2	14.29%	3.64%	24.50%	3.94%	7.53%
11	APERAM	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
12	ARGENX	8	1	12.50%	0	0.00%	0.00%	0.00%	0.00%	0.00%
13	ASCENCIO	8	2	25.00%	0	0.00%	0.91%	12.56%	0.00%	0.01%
14	ASIT	9	1	11.11%	0	0.00%	0.00%	0.00%	0.00%	0.00%
15	ATENOR	10	3	30.00%	2	20.00%	7.27%	25.97%	4.24%	26.36%
16	AVANTIUM	9	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
17	BANIMMO	12	2	16.67%	0	0.00%	0.91%	18.15%	0.00%	1.15%
18	BANQUE NAT BELGE	10	1	10.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
19	BARCO	11	2	18.18%	4	36.36%	10.00%	29.90%	16.80%	36.66%
20	BEFIMMO	10	3	30.00%	0	0.00%	1.82%	14.55%	1.65%	0.06%
21	BEKAERT	20	6	30.00%	1	5.00%	2.73%	17.93%	1.38%	0.48%
22	BELRECA	4	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
23	BELUGA	7	0	0.00%	0	0.00%	0.91%	0.91%	0.00%	0.00%
24	BIOCARTIS	8	2	25.00%	1	12.50%	1.82%	19.22%	0.00%	2.39%
25	BONE THERAPEUTICS	10	0	0.00%	1	10.00%	1.82%	12.56%	0.00%	0.02%
26	BPOST	12	4	33.33%	2	16.67%	3.64%	24.98%	1.15%	12.80%
27	BREDERODE	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
28	CAMPINE	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
29	CARE PROPERTY INVEST	11	4	36.36%	0	0.00%	0.00%	0.00%	0.00%	0.00%
30	CELYAD	8	0	0.00%	1	12.50%	2.73%	12.57%	1.65%	0.02%

31	CENERGY	7	1	14.29%	0	0.00%	0.91%	0.91%	0.00%	0.00%
32	CFE	10	2	20.00%	0	0.00%	1.82%	18.82%	2.29%	1.21%
33	CIE BOIS SAUVAGE	7	2	28.57%	0	0.00%	0.91%	21.96%	0.00%	4.15%
34	COFINIMMO	12	4	33.33%	0	0.00%	2.73%	22.78%	4.61%	4.61%
35	COLRUYT	8	1	12.50%	1	12.50%	3.64%	16.59%	5.28%	0.30%
36	CONNECT GROUP	9	0	0.00%	0	0.00%	1.82%	12.04%	1.65%	0.01%
37	CURETIS	6	1	16.67%	0	0.00%	0.91%	11.06%	0.00%	0.00%
38	D'IETEREN	11	2	18.18%	2	18.18%	5.45%	24.70%	5.85%	9.70%
39	DALENYS	8	1	12.50%	0	0.00%	0.00%	0.00%	0.00%	0.00%
40	DECEUNINCK	8	3	37.50%	1	12.50%	2.73%	18.86%	5.01%	0.78%
41	DELTA LLOYD	8	2	25.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
42	DEXIA	12	3	25.00%	0	0.00%	1.82%	16.96%	7.92%	0.41%
43	ECKERT ZIEGLER	6	1	16.67%	0	0.00%	0.00%	0.00%	0.00%	0.00%
44	ECONOCOM	14	4	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
45	ELIA	14	5	35.71%	3	21.43%	8.18%	27.38%	11.23%	24.14%
46	EMAKINA	9	2	22.22%	1	11.11%	1.82%	15.87%	0.00%	0.18%
47	ENGIE	21	11	52.38%	1	4.76%	3.64%	20.34%	9.46%	2.34%
48	ENVIPCO	6	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
49	EURONAV	8	3	37.50%	0	0.00%	0.00%	0.00%	0.00%	0.00%
50	EURONEXT	9	3	33.33%	0	0.00%	0.91%	12.25%	0.00%	0.01%
51	EVS	7	1	14.29%	0	0.00%	0.91%	19.14%	0.00%	1.36%
52	EXMAR	11	3	27.27%	3	27.27%	6.36%	26.43%	6.44%	22.11%
53	FAGRON	11	3	27.27%	0	0.00%	0.91%	0.91%	0.00%	0.00%
54	FLORIDIENNE	11	0	0.00%	1	9.09%	3.64%	23.13%	3.06%	9.69%
55	FLUXYS	19	7	36.84%	0	0.00%	1.82%	23.19%	0.00%	10.28%
56	FNG	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
57	FOUNTAIN	6	1	16.67%	0	0.00%	0.91%	0.91%	0.00%	0.00%
58	GALAPAGOS	8	3	37.50%	0	0.00%	0.00%	0.00%	0.00%	0.00%
59	GBL	18	5	27.78%	0	0.00%	1.82%	19.76%	0.00%	1.94%
60	GENKYOTEX	8	2	25.00%	0	0.00%	0.91%	14.14%	0.00%	0.08%
61	GIMV	12	5	41.67%	3	25.00%	6.36%	26.43%	8.31%	20.40%
62	GLOBAL GRAPHICS	4	0	0.00%	0	0.00%	0.91%	12.52%	0.00%	0.01%
63	GREENYARD	11	3	27.27%	1	9.09%	5.45%	26.58%	5.65%	20.64%
64	HAMON	10	2	20.00%	3	30.00%	6.36%	26.35%	5.58%	21.99%
65	HOME INVEST	7	2	28.57%	1	14.29%	2.73%	21.24%	4.35%	4.28%
66	IBA	9	3	33.33%	0	0.00%	0.00%	0.00%	0.00%	0.00%
67	IEP INVEST	3	1	33.33%	0	0.00%	1.82%	20.85%	0.02%	5.03%

68	IMMO BEAULIEU	8	3	37.50%	0	0.00%	1.82%	19.55%	1.65%	1.69%
69	IMMO LUX AIRPORT	6	3	50.00%	0	0.00%	0.91%	16.12%	0.00%	0.28%
70	IMMO MOURY	5	0	0.00%	0	0.00%	0.91%	0.91%	0.00%	0.00%
71	IMMOBEL	9	4	44.44%	0	0.00%	1.82%	18.15%	3.09%	0.77%
72	ING	15	2	13.33%	1	6.67%	2.73%	21.80%	0.00%	8.54%
73	INTERVEST	6	2	33.33%	1	16.67%	1.82%	16.50%	0.00%	0.46%
74	JENSEN GROUP	6	1	16.67%	1	16.67%	0.91%	12.25%	0.00%	0.01%
75	KBC	15	5	33.33%	2	13.33%	10.00%	29.33%	21.18%	36.84%
76	KBC ANCORA	9	2	22.22%	0	0.00%	0.91%	22.23%	0.00%	6.21%
77	KEYWARE	6	0	0.00%	0	0.00%	3.64%	14.50%	6.46%	0.08%
78	KIADIS	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
79	KINEPOLIS	9	3	33.33%	1	11.11%	3.64%	24.64%	6.03%	10.43%
80	KKO INTERNATIONAL	5	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
81	LEASINVEST	9	1	11.11%	0	0.00%	2.73%	17.22%	3.57%	0.37%
82	LOTUS BAKERIES	10	4	40.00%	1	10.00%	4.55%	22.84%	11.76%	4.12%
83	MDXHEALTH	6	1	16.67%	1	16.67%	1.82%	19.22%	0.00%	2.39%
84	MELEXIS	6	3	50.00%	0	0.00%	0.91%	19.47%	0.00%	1.54%
85	MIKO	11	3	27.27%	0	0.00%	2.73%	19.34%	6.97%	0.99%
86	MITHRA	12	2	16.67%	0	0.00%	0.91%	0.91%	0.00%	0.00%
87	MONTEA	9	2	22.22%	1	11.11%	4.55%	22.61%	6.73%	6.83%
88	MOURY CONSTRUCT	6	0	0.00%	0	0.00%	0.91%	0.91%	0.00%	0.00%
89	NYRSTAR	8	2	25.00%	1	12.50%	2.73%	22.45%	2.21%	4.72%
90	OIM	6	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
91	ONTEX	8	1	12.50%	1	12.50%	3.64%	25.25%	1.65%	14.18%
92	OPTION	11	1	9.09%	0	0.00%	1.82%	13.82%	3.27%	0.03%
93	OPTION TRADING CO	2	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
94	ORANGE BE	12	3	25.00%	0	0.00%	0.91%	20.25%	0.00%	4.45%
95	PCB	8	1	12.50%	0	0.00%	0.00%	0.00%	0.00%	0.00%
96	PICANOL	6	0	0.00%	0	0.00%	1.82%	17.76%	0.78%	0.80%
97	PROXIMUS	14	6	42.86%	2	14.29%	4.55%	24.18%	5.72%	8.06%
98	QRF	6	2	33.33%	0	0.00%	0.91%	19.81%	0.00%	2.39%
99	QUEST for GROWTH	11	2	18.18%	1	9.09%	5.45%	24.24%	8.76%	11.77%
100	REALDOLMEN	7	3	42.86%	0	0.00%	2.73%	14.14%	3.29%	0.05%
101	RECTICEL	12	3	25.00%	3	25.00%	10.00%	28.86%	17.92%	24.57%
102	RESILUX	7	0	0.00%	0	0.00%	1.82%	16.15%	4.85%	0.17%
103	RETAIL EST	11	3	27.27%	0	0.00%	2.73%	19.22%	3.39%	0.91%

104	ROSIER	7	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
105	ROULARTA	9	2	22.22%	1	11.11%	1.82%	20.90%	0.00%	4.17%
106	RTL GROUP	12	1	8.33%	0	0.00%	0.00%	0.00%	0.00%	0.00%
107	SABCA	10	0	0.00%	1	10.00%	1.82%	21.85%	0.00%	5.37%
108	SAINT GOBAIN	16	5	31.25%	0	0.00%	1.82%	17.42%	1.25%	0.48%
109	SAPEC	8	2	25.00%	0	0.00%	1.82%	19.85%	0.25%	1.79%
110	SKV	10	2	20.00%	0	0.00%	0.91%	19.89%	0.00%	3.30%
111	SIOEN	9	4	44.44%	1	11.11%	5.45%	25.68%	4.61%	14.87%
112	SIPEF	9	2	22.22%	1	11.11%	2.73%	21.80%	0.00%	8.54%
113	SMARTPHOTO GROUP	9	2	22.22%	1	11.11%	5.45%	25.39%	2.92%	19.56%
114	SSPDE	6	0	0.00%	1	16.67%	1.82%	20.90%	0.00%	2.96%
115	SCB	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
116	SOFINA	13	2	15.38%	0	0.00%	0.00%	0.00%	0.00%	0.00%
117	SOLVAC	13	3	23.08%	0	0.00%	1.82%	17.97%	1.33%	0.75%
118	SOLVAY	15	5	33.33%	1	6.67%	2.73%	15.89%	0.57%	0.22%
119	SPADEL	7	0	0.00%	2	28.57%	4.55%	24.31%	5.12%	7.82%
120	SUCRAF	4	1	25.00%	0	0.00%	0.91%	0.91%	0.00%	0.00%
121	SUEZ	19	8	42.11%	0	0.00%	1.82%	19.76%	0.00%	1.94%
122	TELENET	11	3	27.27%	1	9.09%	2.73%	20.43%	4.34%	1.92%
123	TER BEKE	10	3	30.00%	1	10.00%	3.64%	24.18%	1.08%	9.14%
124	TESSENDERLO	6	2	33.33%	1	16.67%	2.73%	20.52%	1.47%	2.47%
125	TEXAF	9	1	11.11%	0	0.00%	0.91%	10.65%	0.00%	0.00%
126	THROMBOGENICS	9	2	22.22%	1	11.11%	4.55%	24.70%	0.30%	21.39%
127	TIGENIX	5	1	20.00%	0	0.00%	1.82%	20.34%	3.27%	2.85%
128	TINC INVEST	6	1	16.67%	1	16.67%	3.64%	20.07%	4.13%	2.28%
129	TOTAL	12	6	50.00%	1	8.33%	3.64%	20.34%	2.37%	2.35%
130	TUBIZE FIN	10	3	30.00%	1	10.00%	1.82%	15.05%	0.00%	0.12%
131	UCB	13	3	23.08%	2	15.38%	3.64%	17.62%	2.18%	0.46%
132	UMICORE	12	3	25.00%	2	16.67%	7.27%	24.70%	18.45%	9.13%
133	VAN DE VELDE	9	2	22.22%	1	11.11%	3.64%	24.50%	4.57%	7.02%
134	VASTNED BE	9	2	22.22%	1	11.11%	1.82%	16.50%	0.00%	0.46%
135	VGP	4	0	0.00%	0	0.00%	0.00%	0.00%	0.00%	0.00%
136	VIOHALCO	12	0	0.00%	0	0.00%	0.91%	0.91%	0.00%	0.00%
137	WAREHOUSES DE PAUW	6	2	33.33%	0	0.00%	2.73%	20.48%	3.42%	1.56%
138	WAREHOUSES ESTATES	7	2	28.57%	0	0.00%	0.00%	0.00%	0.00%	0.00%
139	WERELDHAVE BE	5	0	0.00%	2	40.00%	3.64%	23.80%	1.22%	7.71%

140	XIOR	6	1	16.67%	0	0.00%	1.82%	17.28%	0.82%	0.42%
141	ZENITEL	7	1	14.29%	0	0.00%	0.91%	0.91%	0.00%	0.00%
142	ZETES IND	11	2	18.18%	1	9.09%	2.73%	22.67%	0.94%	6.01%

Appendix 6 Regression outputs

Dependent Variable: RETURN_ON_ASSETS
Method: Least Squares
Date: 06/02/17 Time: 22:53
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.191860	0.138767	-1.382603	0.1681
D_QUINT	-0.001632	0.009080	-0.179718	0.8575
LBM	-0.368546	0.202131	-1.823304	0.0695
SIZE	-0.037894	0.051899	-0.730153	0.4660
LEVERAGE	-0.275303	0.041169	-6.687186	0.0000
ASSETS	0.086500	0.049532	1.746355	0.0820

R-squared	0.211710	Mean dependent var	0.003054
Adjusted R-squared	0.195219	S.D. dependent var	0.215301
S.E. of regression	0.193145	Akaike info criterion	-0.426562
Sum squared resid	8.915934	Schwarz criterion	-0.340816
Log likelihood	58.25379	Hannan-Quinn criter.	-0.392032
F-statistic	12.83760	Durbin-Watson stat	2.088551
Prob(F-statistic)	0.000000		

Dependent Variable: RETURN_ON_ASSETS
Method: Least Squares
Date: 06/02/17 Time: 23:00
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.196995	0.138539	-1.421951	0.1563
C_QUINT	-0.003818	0.009374	-0.407322	0.6841
LBM	-0.365529	0.201990	-1.809643	0.0716
SIZE	-0.037376	0.051774	-0.721909	0.4711
LEVERAGE	-0.275092	0.041032	-6.704354	0.0000
ASSETS	0.087210	0.049555	1.759856	0.0797

R-squared	0.212151	Mean dependent var	0.003054
Adjusted R-squared	0.195668	S.D. dependent var	0.215301
S.E. of regression	0.193091	Akaike info criterion	-0.427120
Sum squared resid	8.910953	Schwarz criterion	-0.341375
Log likelihood	58.32224	Hannan-Quinn criter.	-0.392591
F-statistic	12.87150	Durbin-Watson stat	2.090614
Prob(F-statistic)	0.000000		

Dependent Variable: RETURN_ON_ASSETS
Method: Least Squares
Date: 06/02/17 Time: 23:04
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.182846	0.139551	-1.310243	0.1914
B_QUINT	0.001263	0.007857	0.160783	0.8724
LBM	-0.375810	0.203493	-1.846796	0.0660
SIZE	-0.039948	0.052211	-0.765128	0.4449
LEVERAGE	-0.277154	0.041598	-6.662723	0.0000
ASSETS	0.086851	0.049614	1.750555	0.0813

R-squared	0.211689	Mean dependent var	0.003054
Adjusted R-squared	0.195197	S.D. dependent var	0.215301
S.E. of regression	0.193148	Akaike info criterion	-0.426535
Sum squared resid	8.916175	Schwarz criterion	-0.340789
Log likelihood	58.25048	Hannan-Quinn criter.	-0.392005
F-statistic	12.83597	Durbin-Watson stat	2.083307
Prob(F-statistic)	0.000000		

Dependent Variable: RETURN_ON_ASSETS
Method: Least Squares
Date: 06/02/17 Time: 23:07
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.191860	0.138767	-1.382603	0.1681
D_QUINT	-0.001632	0.009080	-0.179718	0.8575
LBM	-0.368546	0.202131	-1.823304	0.0695
SIZE	-0.037894	0.051899	-0.730153	0.4660
LEVERAGE	-0.275303	0.041169	-6.687186	0.0000
ASSETS	0.086500	0.049532	1.746355	0.0820

R-squared	0.211710	Mean dependent var	0.003054
Adjusted R-squared	0.195219	S.D. dependent var	0.215301
S.E. of regression	0.193145	Akaike info criterion	-0.426562
Sum squared resid	8.915934	Schwarz criterion	-0.340816
Log likelihood	58.25379	Hannan-Quinn criter.	-0.392032
F-statistic	12.83760	Durbin-Watson stat	2.088551
Prob(F-statistic)	0.000000		

Dependent Variable: RETURN_ON_ASSETS
Method: Least Squares
Date: 06/02/17 Time: 23:19
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.196074	0.139257	-1.408000	0.1604
N_SCORE	-0.002959	0.009357	-0.316255	0.7521
LBM	-0.365267	0.202421	-1.804491	0.0724
SIZE	-0.036822	0.052030	-0.707714	0.4798
LEVERAGE	-0.274606	0.041215	-6.662822	0.0000
ASSETS	0.086260	0.049522	1.741840	0.0828

R-squared	0.211934	Mean dependent var	0.003054
Adjusted R-squared	0.195447	S.D. dependent var	0.215301
S.E. of regression	0.193118	Akaike info criterion	-0.426845
Sum squared resid	8.913409	Schwarz criterion	-0.341100
Log likelihood	58.28848	Hannan-Quinn criter.	-0.392315
F-statistic	12.85478	Durbin-Watson stat	2.090895
Prob(F-statistic)	0.000000		

Dependent Variable: TOBIN_S_Q
Method: Least Squares
Date: 06/02/17 Time: 23:26
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.154817	0.406210	5.304686	0.0000
D_QUINT	0.006181	0.026581	0.232551	0.8163
LBM	-2.601702	0.591693	-4.397049	0.0000
SIZE	1.429399	0.151921	9.408811	0.0000
LEVERAGE	0.934234	0.120512	7.752188	0.0000
ASSETS	-1.453073	0.144994	-10.02163	0.0000

R-squared	0.694791	Mean dependent var	1.444557
Adjusted R-squared	0.688406	S.D. dependent var	1.012871
S.E. of regression	0.565390	Akaike info criterion	1.721584
Sum squared resid	76.40022	Schwarz criterion	1.807329
Log likelihood	-204.8940	Hannan-Quinn criter.	1.756114
F-statistic	108.8141	Durbin-Watson stat	1.830275
Prob(F-statistic)	0.000000		

Dependent Variable: TOBIN_S_Q
Method: Least Squares
Date: 06/02/17 Time: 23:30
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.196244	0.405091	5.421613	0.0000
C_QUINT	0.023253	0.027409	0.848367	0.3971
LBM	-2.626415	0.590623	-4.446852	0.0000
SIZE	1.424270	0.151389	9.408026	0.0000
LEVERAGE	0.931325	0.119978	7.762459	0.0000
ASSETS	-1.457665	0.144901	-10.05971	0.0000

R-squared	0.695639	Mean dependent var	1.444557
Adjusted R-squared	0.689271	S.D. dependent var	1.012871
S.E. of regression	0.564605	Akaike info criterion	1.718803
Sum squared resid	76.18807	Schwarz criterion	1.804548
Log likelihood	-204.5534	Hannan-Quinn criter.	1.753333
F-statistic	109.2502	Durbin-Watson stat	1.826518
Prob(F-statistic)	0.000000		

Dependent Variable: TOBIN_S_Q
Method: Least Squares
Date: 06/02/17 Time: 23:35
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.156044	0.408507	5.277859	0.0000
B_QUINT	0.004920	0.023000	0.213923	0.8308
LBM	-2.608828	0.595683	-4.379555	0.0000
SIZE	1.427996	0.152837	9.343274	0.0000
LEVERAGE	0.932438	0.121768	7.657468	0.0000
ASSETS	-1.450813	0.145233	-9.989548	0.0000

R-squared	0.694781	Mean dependent var	1.444557
Adjusted R-squared	0.688395	S.D. dependent var	1.012871
S.E. of regression	0.565400	Akaike info criterion	1.721619
Sum squared resid	76.40288	Schwarz criterion	1.807364
Log likelihood	-204.8983	Hannan-Quinn criter.	1.756148
F-statistic	108.8087	Durbin-Watson stat	1.830124
Prob(F-statistic)	0.000000		

Dependent Variable: TOBIN_S_Q
Method: Least Squares
Date: 06/02/17 Time: 23:38
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.188596	0.405970	5.391024	0.0000
E_QUINT	0.019176	0.027529	0.696558	0.4868
LBM	-2.617758	0.590683	-4.431750	0.0000
SIZE	1.426435	0.151403	9.421423	0.0000
LEVERAGE	0.933268	0.119970	7.779183	0.0000
ASSETS	-1.457867	0.145045	-10.05110	0.0000

R-squared	0.695341	Mean dependent var	1.444557
Adjusted R-squared	0.688967	S.D. dependent var	1.012871
S.E. of regression	0.564881	Akaike info criterion	1.719782
Sum squared resid	76.26269	Schwarz criterion	1.805527
Log likelihood	-204.6733	Hannan-Quinn criter.	1.754312
F-statistic	109.0966	Durbin-Watson stat	1.829172
Prob(F-statistic)	0.000000		

Dependent Variable: TOBIN_S_Q
Method: Least Squares
Date: 06/02/17 Time: 23:40
Sample (adjusted): 1 245
Included observations: 245 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.202109	0.407200	5.407931	0.0000
N_SCORE	0.021958	0.027359	0.802572	0.4230
LBM	-2.636041	0.591897	-4.453550	0.0000
SIZE	1.418329	0.152140	9.322512	0.0000
LEVERAGE	0.926503	0.120515	7.687852	0.0000
ASSETS	-1.451710	0.144807	-10.02513	0.0000

R-squared	0.695543	Mean dependent var	1.444557
Adjusted R-squared	0.689173	S.D. dependent var	1.012871
S.E. of regression	0.564694	Akaike info criterion	1.719119
Sum squared resid	76.21211	Schwarz criterion	1.804864
Log likelihood	-204.5921	Hannan-Quinn criter.	1.753648
F-statistic	109.2007	Durbin-Watson stat	1.826836
Prob(F-statistic)	0.000000		

Dependent Variable: DELTA_ROA
Method: Least Squares
Date: 06/03/17 Time: 00:03
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-24.93473	28.29548	-0.881227	0.3801
D_QUINT	0.931788	1.719572	0.541872	0.5890
LBM	-64.36961	47.14093	-1.365472	0.1749
SIZE	-23.46211	13.91878	-1.685645	0.0947
LEVERAGE	-42.51816	15.03150	-2.828605	0.0056
ASSETS	29.52599	13.66220	2.161145	0.0329

R-squared	0.135165	Mean dependent var	-2.370252
Adjusted R-squared	0.095494	S.D. dependent var	25.30454
S.E. of regression	24.06602	Akaike info criterion	9.250242
Sum squared resid	63129.87	Schwarz criterion	9.393456
Log likelihood	-525.8889	Hannan-Quinn criter.	9.308372
F-statistic	3.407124	Durbin-Watson stat	2.181549
Prob(F-statistic)	0.006723		

Dependent Variable: DELTA_ROA
Method: Least Squares
Date: 06/03/17 Time: 00:07
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-26.71888	27.94857	-0.956001	0.3412
C_QUINT	0.659403	1.721474	0.383046	0.7024
LBM	-62.44257	46.90516	-1.331252	0.1859
SIZE	-22.92544	13.86097	-1.653956	0.1010
LEVERAGE	-41.83621	14.94593	-2.799170	0.0061
ASSETS	29.20904	13.66280	2.137852	0.0348

R-squared	0.134001	Mean dependent var	-2.370252
Adjusted R-squared	0.094276	S.D. dependent var	25.30454
S.E. of regression	24.08221	Akaike info criterion	9.251587
Sum squared resid	63214.84	Schwarz criterion	9.394801
Log likelihood	-525.9663	Hannan-Quinn criter.	9.309717
F-statistic	3.373243	Durbin-Watson stat	2.177254
Prob(F-statistic)	0.007153		

Dependent Variable: DELTA_ROA
Method: Least Squares
Date: 06/03/17 Time: 00:11
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-25.31856	28.25528	-0.896065	0.3722
B_QUINT	0.736634	1.465057	0.502802	0.6161
LBM	-63.94803	47.10981	-1.357425	0.1775
SIZE	-23.41581	13.92587	-1.681461	0.0955
LEVERAGE	-42.95795	15.20281	-2.825659	0.0056
ASSETS	29.64268	13.67732	2.167287	0.0324

R-squared	0.134842	Mean dependent var	-2.370252
Adjusted R-squared	0.095156	S.D. dependent var	25.30454
S.E. of regression	24.07051	Akaike info criterion	9.250616
Sum squared resid	63153.46	Schwarz criterion	9.393829
Log likelihood	-525.9104	Hannan-Quinn criter.	9.308745
F-statistic	3.397711	Durbin-Watson stat	2.175433
Prob(F-statistic)	0.006840		

Dependent Variable: DELTA_ROA
Method: Least Squares
Date: 06/03/17 Time: 00:14
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-28.11015	28.38105	-0.990455	0.3241
E_QUINT	0.220381	1.776269	0.124069	0.9015
LBM	-61.01368	46.96535	-1.299121	0.1966
SIZE	-22.71938	13.89662	-1.634885	0.1050
LEVERAGE	-41.54139	14.93847	-2.780833	0.0064
ASSETS	29.25411	13.67049	2.139946	0.0346

R-squared	0.132958	Mean dependent var	-2.370252
Adjusted R-squared	0.093185	S.D. dependent var	25.30454
S.E. of regression	24.09671	Akaike info criterion	9.252791
Sum squared resid	63291.00	Schwarz criterion	9.396005
Log likelihood	-526.0355	Hannan-Quinn criter.	9.310921
F-statistic	3.342954	Durbin-Watson stat	2.179674
Prob(F-statistic)	0.007560		

Dependent Variable: DELTA_ROA
Method: Least Squares
Date: 06/03/17 Time: 00:18
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-24.88538	28.32310	-0.878625	0.3815
N_SCORE	0.935449	1.728564	0.541171	0.5895
LBM	-64.36119	47.14016	-1.365316	0.1750
SIZE	-23.63096	13.95994	-1.692770	0.0934
LEVERAGE	-42.48578	15.02416	-2.827831	0.0056
ASSETS	29.68120	13.67577	2.170350	0.0322

R-squared	0.135159	Mean dependent var	-2.370252
Adjusted R-squared	0.095488	S.D. dependent var	25.30454
S.E. of regression	24.06610	Akaike info criterion	9.250249
Sum squared resid	63130.31	Schwarz criterion	9.393463
Log likelihood	-525.8893	Hannan-Quinn criter.	9.308379
F-statistic	3.406949	Durbin-Watson stat	2.179261
Prob(F-statistic)	0.006725		

Dependent Variable: DELTA_TOBIN_S_Q
Method: Least Squares
Date: 06/03/17 Time: 00:23
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	471.2525	518.8395	0.908282	0.3657
D_QUINT	-16.75377	31.53090	-0.531345	0.5963
LBM	1144.423	864.3987	1.323952	0.1883
SIZE	421.3660	255.2214	1.650982	0.1016
LEVERAGE	771.1530	275.6248	2.797836	0.0061
ASSETS	-532.8827	250.5166	-2.127135	0.0357

R-squared	0.134401	Mean dependent var	43.39084
Adjusted R-squared	0.094695	S.D. dependent var	463.7914
S.E. of regression	441.2861	Akaike info criterion	15.06803
Sum squared resid	21225941	Schwarz criterion	15.21124
Log likelihood	-860.4116	Hannan-Quinn criter.	15.12616
F-statistic	3.384878	Durbin-Watson stat	2.181519
Prob(F-statistic)	0.007002		

Dependent Variable: DELTA_TOBIN_S_Q
Method: Least Squares
Date: 06/03/17 Time: 00:40
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	503.8479	512.4733	0.983169	0.3277
C_QUINT	-11.71234	31.56546	-0.371049	0.7113
LBM	1109.302	860.0668	1.289786	0.1999
SIZE	411.6365	254.1589	1.619603	0.1082
LEVERAGE	758.8076	274.0530	2.768835	0.0066
ASSETS	-527.1938	250.5251	-2.104356	0.0376

R-squared	0.133254	Mean dependent var	43.39084
Adjusted R-squared	0.093495	S.D. dependent var	463.7914
S.E. of regression	441.5784	Akaike info criterion	15.06935
Sum squared resid	21254073	Schwarz criterion	15.21257
Log likelihood	-860.4877	Hannan-Quinn criter.	15.12748
F-statistic	3.351542	Durbin-Watson stat	2.177437
Prob(F-statistic)	0.007443		

Dependent Variable: DELTA_TOBIN_S_Q
Method: Least Squares
Date: 06/03/17 Time: 00:44
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	478.2695	518.1007	0.923121	0.3580
B_QUINT	-13.22223	26.86390	-0.492193	0.6236
LBM	1136.730	863.8253	1.315926	0.1910
SIZE	420.5071	255.3507	1.646783	0.1025
LEVERAGE	779.0143	278.7651	2.794519	0.0061
ASSETS	-534.9689	250.7931	-2.133108	0.0352

R-squared	0.134084	Mean dependent var	43.39084
Adjusted R-squared	0.094363	S.D. dependent var	463.7914
S.E. of regression	441.3670	Akaike info criterion	15.06839
Sum squared resid	21233727	Schwarz criterion	15.21161
Log likelihood	-860.4327	Hannan-Quinn criter.	15.12652
F-statistic	3.375643	Durbin-Watson stat	2.175626
Prob(F-statistic)	0.007122		

Dependent Variable: DELTA_TOBIN_S_Q
Method: Least Squares
Date: 06/03/17 Time: 00:52
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	529.6235	520.3881	1.017747	0.3111
E_QUINT	-3.673617	32.56924	-0.112794	0.9104
LBM	1083.122	861.1452	1.257769	0.2112
SIZE	407.8011	254.8051	1.600443	0.1124
LEVERAGE	753.4741	273.9082	2.750827	0.0070
ASSETS	-527.9960	250.6588	-2.106433	0.0375

R-squared	0.132260	Mean dependent var	43.39084
Adjusted R-squared	0.092456	S.D. dependent var	463.7914
S.E. of regression	441.8314	Akaike info criterion	15.07050
Sum squared resid	21278436	Schwarz criterion	15.21371
Log likelihood	-860.5536	Hannan-Quinn criter.	15.12863
F-statistic	3.322745	Durbin-Watson stat	2.179945
Prob(F-statistic)	0.007845		

Dependent Variable: DELTA_TOBIN_S_Q
Method: Least Squares
Date: 06/03/17 Time: 00:54
Sample (adjusted): 1 115
Included observations: 115 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	470.7502	519.3527	0.906417	0.3667
N_SCORE	-16.73381	31.69619	-0.527944	0.5986
LBM	1143.897	864.3960	1.323349	0.1885
SIZE	424.3036	255.9795	1.657569	0.1003
LEVERAGE	770.4761	275.4938	2.796709	0.0061
ASSETS	-535.6343	250.7687	-2.135970	0.0349

R-squared	0.134373	Mean dependent var	43.39084
Adjusted R-squared	0.094665	S.D. dependent var	463.7914
S.E. of regression	441.2934	Akaike info criterion	15.06806
Sum squared resid	21226641	Schwarz criterion	15.21127
Log likelihood	-860.4135	Hannan-Quinn criter.	15.12619
F-statistic	3.384048	Durbin-Watson stat	2.179290
Prob(F-statistic)	0.007013		

Appendix7 Correlation matrices

Covariance Analysis: Spearman rank-order
Date: 06/06/17 Time: 07:57
Sample (adjusted): 1 115
Included observations: 115 after adjustments
Balanced sample (listwise missing value deletion)

Correlation	D_QUINT	C_QUINT	B_QUINT	E_QUINT	LBM	SIZE	LEVERAGE	ASSETS
D_QUINT	1.000000							
C_QUINT	0.921103	1.000000						
B_QUINT	0.861542	0.814824	1.000000					
E_QUINT	0.933396	0.950570	0.780758	1.000000				
LBM	0.070421	0.089195	0.014137	0.081399	1.000000			
SIZE	0.428505	0.416296	0.354609	0.472976	-0.219072	1.000000		
LEVERAGE	0.114661	0.072368	0.214409	0.033156	-0.272516	0.052813	1.000000	
ASSETS	0.486274	0.473767	0.413631	0.517713	0.066796	0.900260	0.207780	1.000000

Covariance Analysis: Spearman rank-order
Date: 06/06/17 Time: 08:13
Sample: 1 58
Included observations: 58

Correlation	D_QUINT	C_QUINT	B_QUINT	E_QUINT	LBM	SIZE	LEVERAGE	ASSETS
D_QUINT	1.000000							
C_QUINT	0.814715	1.000000						
B_QUINT	0.831804	0.757607	1.000000					
E_QUINT	0.838423	0.885401	0.669373	1.000000				
LBM	0.110523	0.108107	-0.000161	0.060816	1.000000			
SIZE	0.357579	0.265945	0.305339	0.410796	-0.136055	1.000000		
LEVERAGE	0.244872	0.088564	0.374557	0.079188	-0.187302	0.148174	1.000000	
ASSETS	0.439781	0.343739	0.357896	0.463376	0.297364	0.832969	0.277000	1.000000

Appendix 8 Outputs of the White Heteroscedasticity tests

Heteroskedasticity Test: White

F-statistic	5.013966	Prob. F(20,94)	0.0000
Obs*R-squared	59.35847	Prob. Chi-Square(20)	0.0000
Scaled explained SS	838.3143	Prob. Chi-Square(20)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/06/17 Time: 08:02
Sample: 1 115
Included observations: 115

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.033569	3.080279	0.010898	0.9913
D_QUINT^2	-0.001990	0.010575	-0.188168	0.8512
D_QUINT*LBM	-1.240869	0.488363	-2.540876	0.0127
D_QUINT*SIZE	-0.302377	0.122611	-2.466155	0.0155
D_QUINT*LEVERAGE	-0.248911	0.142409	-1.747865	0.0838
D_QUINT*ASSETS	0.320705	0.119606	2.681332	0.0087
D_QUINT	0.248024	0.215827	1.149176	0.2534
LBM^2	19.77362	5.503688	3.592794	0.0005
LBM*SIZE	14.55918	4.312674	3.375905	0.0011
LBM*LEVERAGE	10.02936	5.236223	1.915380	0.0585
LBM*ASSETS	-14.58790	4.029531	-3.620247	0.0005
LBM	-9.187652	8.808348	-1.043062	0.2996
SIZE^2	2.183647	0.714811	3.054861	0.0029
SIZE*LEVERAGE	3.115539	1.284380	2.425715	0.0172
SIZE*ASSETS	-4.502565	1.374253	-3.276371	0.0015
SIZE	-2.614516	2.506224	-1.043209	0.2995
LEVERAGE^2	1.277356	0.673111	1.897690	0.0608
LEVERAGE*ASSETS	-3.154025	1.220834	-2.583500	0.0113
LEVERAGE	-2.427422	2.549866	-0.951981	0.3435
ASSETS^2	2.299711	0.673542	3.414356	0.0009
ASSETS	2.901865	2.200261	1.318873	0.1904

R-squared	0.516161	Mean dependent var	0.036061
Adjusted R-squared	0.413216	S.D. dependent var	0.203085
S.E. of regression	0.155567	Akaike info criterion	-0.719904
Sum squared resid	2.274894	Schwarz criterion	-0.218656
Log likelihood	62.39449	Hannan-Quinn criter.	-0.516450
F-statistic	5.013966	Durbin-Watson stat	1.964930
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: White

F-statistic	37.76372	Prob. F(20,94)	0.0000
Obs*R-squared	102.2715	Prob. Chi-Square(20)	0.0000
Scaled explained SS	1014.580	Prob. Chi-Square(20)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/06/17 Time: 08:09
Sample: 1 115
Included observations: 115

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.21293	6.905539	-1.913381	0.0587
D_QUINT^2	-0.016854	0.023708	-0.710916	0.4789
D_QUINT*LBM	2.403008	1.094838	2.194852	0.0306
D_QUINT*SIZE	0.397306	0.274876	1.445400	0.1517
D_QUINT*LEVERAGE	0.240041	0.319259	0.751869	0.4540
D_QUINT*ASSETS	-0.385447	0.268140	-1.437483	0.1539
D_QUINT	-0.744737	0.483854	-1.539178	0.1271
LBM^2	16.30706	12.33847	1.321643	0.1895
LBM*SIZE	58.62043	9.668391	6.063101	0.0000
LBM*LEVERAGE	77.06630	11.73885	6.565061	0.0000
LBM*ASSETS	-57.74916	9.033625	-6.392689	0.0000
LBM	35.05258	19.74704	1.775080	0.0791
SIZE^2	17.30757	1.602502	10.80034	0.0000
SIZE*LEVERAGE	4.587139	2.879393	1.593092	0.1145
SIZE*ASSETS	-34.32021	3.080877	-11.13975	0.0000
SIZE	6.312672	5.618592	1.123533	0.2641
LEVERAGE^2	3.432051	1.509018	2.274361	0.0252
LEVERAGE*ASSETS	-4.378393	2.736934	-1.599744	0.1130
LEVERAGE	-11.23668	5.716430	-1.965681	0.0523
ASSETS^2	17.00197	1.509983	11.25971	0.0000
ASSETS	-6.415740	4.932668	-1.300663	0.1966

R-squared	0.889317	Mean dependent var	0.201673
Adjusted R-squared	0.865768	S.D. dependent var	0.951910
S.E. of regression	0.348758	Akaike info criterion	0.894703
Sum squared resid	11.43343	Schwarz criterion	1.395952
Log likelihood	-30.44545	Hannan-Quinn criter.	1.098158
F-statistic	37.76372	Durbin-Watson stat	1.908260
Prob(F-statistic)	0.000000		