UNIVERSITE CATHOLIQUE DE LOUVAIN

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and

UNIVERSIDADE DE LISBOA

INSTITUTO SUPERIOR TÉCNICO

DRIVERS OF FIRM GROWTH: A CASE STUDY IN THE BELGIAN CHEMICAL INDUSTRY

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Research [Project based] Master's Thesis

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With a view of getting the degrees

Mestrado em Engenharia e Gestão Industrial Master in Business Engineering

ACADEMIC YEAR 2014-2015

Foreword

I would like to thank Prof. Benoit Gailly for the opportunity of working under his guidance. His brilliant recommendations and support were fundamental to the execution of this thesis.

My thanks to Prof. José Rui Figueira, for his supervision, constant availability and most importantly, his friendship during my graduate studies.

I wish to express my unqualified thanks to Mr. François Cornélis, for giving me the opportunity to complete my master with an interesting thesis's theme, and for all the support that greatly enriched this work. It was truly an honor.

I must also state my gratitude to Filipe Rebelo, for his inspiration and motivation that changed all my academic path.

To my friends and colleagues, specially David Cruz e Silva for his frequent help and support.

To my family, particularly my grandfather, for all their unconditional love and continuous encouragement throughout my years of study.

Finally, and most importantly, to Vanessa, for her special support and comprehension.

Contents

1. Introduction

This part is divided into three chapters. The first is devoted to explain the context of this thesis's theme, namely its origin, the addressed problem and the main concepts that should be clearly defined. The second chapter is dedicated to the statement of author's main motivations that fostered all the curiosity and interest while doing this thesis. Finally, the third chapter will specify the structure of this thesis.

1.1. Context

This thesis had its origin based on a managerial problem concerning the chemical industry in Belgium. The theme of this thesis was firstly proposed by Mr. François Cornélis. Mr. Cornélis served as the President of Chemicals Division at Total SA, and is currently the Ad Interim Chief Executive Officer of Elia System Operator SA. In a general way, this thesis subject matter encloses a growth analysis concerning a set of the most well known Belgian firms in the chemical industry.

First, one has to understand what growth means or, in another words, how growth can be measured. For this thesis, growth will refer to sales growth. However, note that the concept of growth has been intensely addressed by scholars mainly within firm growth literature, and is often measured in different ways, such as number of employees and market capitalization. Second, growth is a time-dependent concept. For this thesis, growth will be analyzed over a period of 12 years, more concretely over the period 2002-13. Third, a proper definition of chemical industry should also be stated. Chemical industry will be used to refer to all the groups and classes within division 20 "Manufacture of chemicals and chemical products" of the classification system defined by the Statistical Classification of Economic Activities in European Community Revision 2 (NACE Rev. 2). Finally, the set of Belgian firms under analysis should also be listed. They are the following ones: Floridienne Group; Sioen Industries; Solvay; Tessenderlo Group; Recticel SA; Agfa-Gevaert.

Henceforth, this thesis is oriented to analyze sales growth over the period 2002-13 of the six presented Belgian firms with main activities in the chemical industry.

1.2. Motivation

Author's motivation to analyze growth of the specified set of firms of the Belgian chemical industry is fostered by three main aspects: *i)* growth differences between the selected firms; *ii)* growth advantages; *iii)* importance of the chemical industry in Belgium.

2.

Concerning the first aspect, as one can see in Figure 1, growth differences between the selected firms are significant. While Floridienne doubled its size over the period 2002-13, Sioen grew much less intensely. Another example that highlights the growth diverseness among this group of firms is that Floridienne, Sioen and Solvay had positive growths between 2002 and 2013, while Tessenderlo, Recticel and Agfa-Gevaert suffered a decline in sales. Within this context, these differences between firms' growth raised the author's curiosity to understand the reasons behind such heterogeneity.

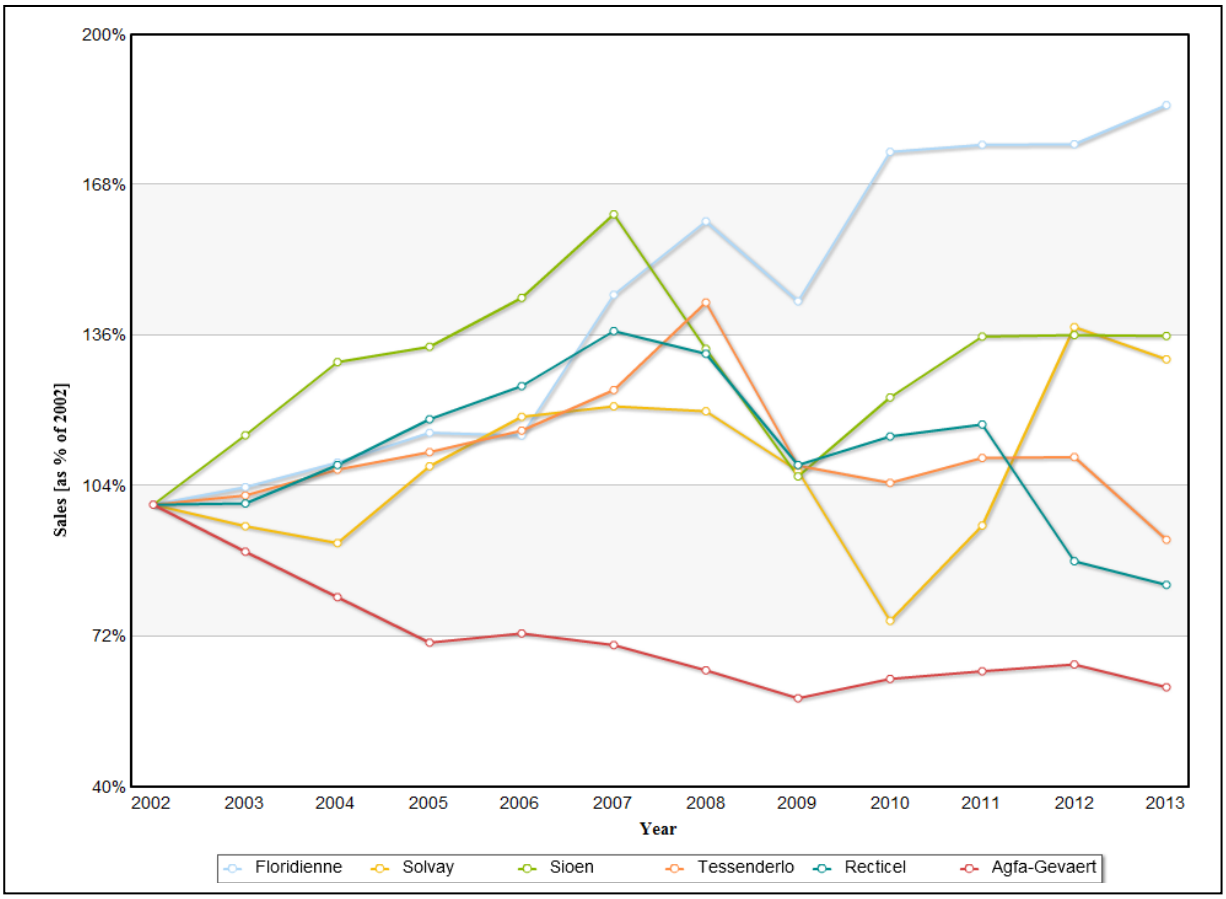

Figure 1 Firms' Sales (%) Relative to Sales in 2002 Over the Period 2002-2013 **Source** The Author based on Floridienne's, Solvay's, Sioen's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports

Concerning the second aspect, the motivation to address this theme is also related with all the advantages that are created by firm's growth. For example, some scholars argue that employees (mainly managers) are more efficient when the firm is growing, given that higher bonuses and opportunities to ascend in firm's hierarchy are usually related with firm's growth level (Coad, 2007a). For established firms, the case of this thesis, growth is also an important strategic aspect, since it is often a mean to sustain, along the time, the viability of the firm (Gailly & Diambeidou, 2011). So, often, growth is associated with survivability (McKinsey &

Company, 2005). On the operational side, growth can also be a means to achieve economies of scale or economies of scope, increasing efficiency and creation of synergies. Growth can also imply the possibility to diversify firm's resources across different businesses, spreading risks (Coad, 2007a). Henceforth, from a managerial point of view, growth can be translated into a significant number of benefits.

Finally, the third aspect is related with the importance of the chemical industry in Belgium. Such importance can be justified by two facts. First, chemical industry is significantly important within Belgium's economy. For example, the share of chemicals in Belgium's economy in 2006 was of 6%, comparing to the EU27 average of roughly 3.5%, and even bigger than Germany's share - of about 4.8% (essenscia, 2013). Second, chemical industry is part of the competitiveness of Belgium as a country, with Belgium being the country presenting the highest ratios in terms of chemical sales per capita in the world (Figure 2).

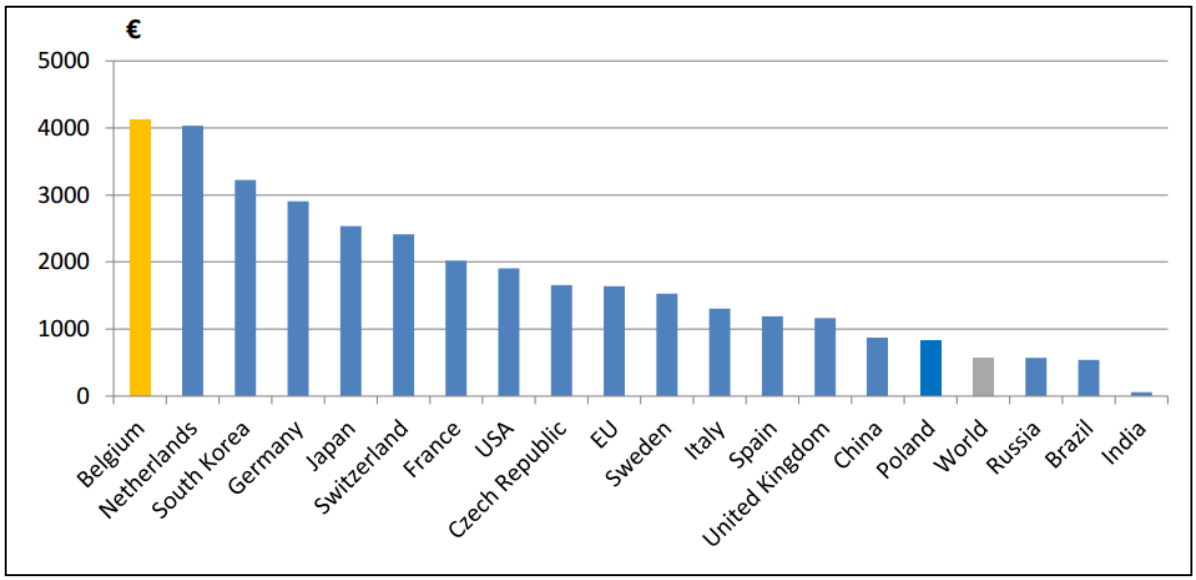

Figure 2 Sales of Chemicals per Capita in 2012 **Source** (essenscia, 2013)

1.3. Structure

At this point, the theme of this thesis was presented - a sales growth analysis of the chemical Belgian firms - as well as the motivation behind it. In order to tackle this theme, one should, first of all, understand what are the factors that can affect growth. For this, Part 2 is devoted to a literature review oriented to identify such factors, which from now forward will be referred as growth drivers.

Given a list of growth drivers, Part 3 explains the methodology to analyze sales growth of the chemical Belgian firms. Chapter 3.2. addresses the basilar point of the methodology: the

growth analysis is based on a comparative analysis between the Belgian firms and two benchmarks, namely BASF and The Dow Chemical Company. In such comparison, two groups are defined: one that grew significantly more over the period 2002-13 (benchmarks); another one with lower and even negative growth rates (rest of the firms). In this context, the main objective of this thesis is to explain the reasons behind these growth differences.

Chapter 3.3. presents the methodology for this purpose. It starts by stating that, from the list of the growth drivers identified in Part 2, four were selected due to their relevance for this case study. In this context, note that growth differences between benchmarks and rest of the firms are caused by growth drivers that not only impacted growth, but also that distinguish benchmarks from the rest of the firms. In this sense, Section 3.3.1. explains the methodology to identify growth drivers that impacted firms' growth (referred as sub-objective *i*); Section 3.3.2. describes the methodology to identify the growth drivers that distinguish benchmarks from the rest of the firms (referred as sub-objective *ii*).

After the methodology, Part 4 is dedicated to explain the selection process of the growth drivers considered to be relevant for this case study and the reasons behind such selection.

Following this, Part 5 analyzes individually each selected growth driver. So, there is one chapter for each selected growth driver. Each one of these chapters is divided into four sections: *i)* presentation of the hypothesis being tested; *ii)* statement of growth driver's metric and data collection process; *iii)* analysis of the growth driver's impact on firms' growth; *iv)* analysis of the growth driver as a distinguishing factor. To close this part, Chapter 5.6. addresses the main objective of this thesis: to explain the reasons behind growth differences between benchmarks and rest of the firms.

Finally, Part 6 states an overall conclusion of this thesis, with a brief review of the methodology and findings, presenting the main contributions of this thesis, suggesting further research and also stating the main limitations of the growth analysis.

2. Literature Review

2.1. Introduction

This part is dedicated to a brief literature review oriented to identify a list of growth drivers. With this intent, a special attention should be given to the firm growth literature. To be more concrete, Mckelvie and Wiklund (2010)[1] identified three main fields within firm growth literature, and labeled them as: *i) Growth as an Outcome* - consisting on conceptual and empirical works analyzing growth as an outcome, i.e. as a dependent variable, of a set of independent variables (growth drivers); *ii) The Outcome of Growth* - enclosing works analyzing how growth can affect other variables (so, growth as an independent variable); *iii) The Growth Process* - works focusing on studying firms' growth process. Henceforth, in order to identify a list of growth drivers, a literature review was done concerning works within *Growth as an Outcome* literature. Note that growth drivers concerning only SMEs and new ventures are going to be excluded from this literature review (such as entrepreneurs' will to grow and risk propensity), since the firms under analysis are far from being SMEs (please see Annex 2).

This part is divided into chapters, one for each growth driver. Each growth driver will be analyzed from two perspectives. First, a more conceptual perspective will be presented in order to give a perception of how each growth driver can impact growth. Second, from an empirical perspective, it will be stated an overview of some of the most cited empirical works testing the relation between the growth driver and growth. Finally, Chapter 2.13. is devoted to a brief conclusion of this literature review.

2.2. Acquisitions

As it will be shown, most of the literature is oriented to analyze firms' growth as a consequence of specific drivers, such as R&D or profitability. However, as stated by Mckelvie and Wiklund (2010), scholars should also devote attention to growth modes. Delmar, Davidsson, and Gartner (2003) state that this issue is being "surprisingly" ignored by scholars. Mckelvie and Wiklund (2010) identify three main growth modes: *i)* organic growth; *ii)* growth through acquisitions; *iii)* hybrid mode (e.g. through joint ventures, franchises). In

[1] Note that this taxonomy is mainly suitable for the firm growth literature enclosing SMEs. Nevertheless, it provides a plausible framework that gives the perception of different ways to analyze growth.

this context, this chapter is devoted to understand what is the relation between acquisitions and growth.

Despite the lack of works relating in a conceptual way acquisitions with growth, many scholars addressed acquisitions as a mean that can affect, positively and negatively, firms' performance (in a broader way). On the one side, acquisitions can have several benefits. For example, Penrose (1959) states that acquisitions *"can be a means of obtaining the productive services and knowledge that are necessary for a firm to establish itself in a new field"* (Mckelvie and Wiklund, 2010). Vermeulen and Barkema (2001) also highlight that acquisitions, against organic growth, provide the acquirer a faster way to increase its market power (e.g., through increasing market share), to enter in new markets, to overcome some industries' entry barriers and to acquire resources and knowledge that would be significantly time consuming to obtain organically. Moreover, when acquisitions are realized between related businesses, powerful synergies can be created, impacting firm's performance. Larsson and Finkelstein (1999) summarizes four different types of synergies: *i)* operational synergies (such as in production and R&D), that can be achieved through economies of scale, economies of scope and vertical economies created through acquisitions; *ii)* collusive synergies, due to an increase of market and purchasing power; *iii)* managerial synergies, with the introduction of complementary competencies within the new top management team; *iv)* financial synergies, due to the risk diversification that an acquisition can imply.

On the other side, the acquirer firm can face many obstacles and challenges, impacting negatively firm's performance. Chatterjee, H. Lubatkin, Schweiger, and Weber (1992) address one important issue, namely the cultural fit between the acquirer and the target firm, with culture defined as a *"set of important assumptions that members of a community share in common"*. Such culture is considered to shape every aspect at the relation level between employees. One example concerns the top management team, with leadership styles and administrative procedures influenced by firm's culture. Such dissimilarities can foster a lower cooperation between employees and, since culture is difficult to change, affect significantly acquisition's expected benefits. Hitt, Hoskisson, and Ireland (1990) refer mainly to the managerial commitment that an acquisition requires. Acquisitions lead to larger sized and more diversified firms, which may reduce managers' capability to control already existent operations. Acquisitions may also imply higher debt levels, increasing debt holders' power over the firm, whose interests can be misaligned with firm's strategy (Hitt et al., 1990). The strategic fit between the acquirer and the target firm is also a critical matter, and constitutes

frequently a challenge, impacting negatively acquisition's expected benefits (Cartwright, 2006).

Concerning empirical studies, as already introduced, very few scholars studied the relation between acquisitions and growth. Two examples were found: *i)* one proving evidence that there are firms growing only through acquisitions - i.e. relation between acquisitions and overall growth (Delmar et. al., 2003); *ii)* one analyzing the relationship between acquisitions and organic growth (Lockett, Wiklun, and Davidsson, 2007). First, Delmar et al. (2003) studied an extensive data set concerning a sample of 1501 Sweden firms over the period 1987-96. Among this sample, high growth firms were selected. Authors found that 10% of the high growth firms were "acquisition growers": growing only through acquisitions, with a negative organic growth. This actually proves that acquisitions are a growth mode, regardless their impact on firms' organic growth. Lockett et al. (2007), for the same data used in (Delmar et al., 2003), studied the relationship between acquisitions and organic growth based on a panel data model. However, no significant positive correlation between acquisitions and organic growth was found.

As a form of conclusion, acquisitions can be considered a trade-off, with several benefits but also challenges that should be managed in a proper way. Regarding acquisitions-growth relation, two issues are important to analyze: *i)* the impact of acquisitions on acquirer's organic growth; *ii)* the impact of acquisitions on acquirer's overall growth, since negative effects of acquisitions can cancel growth due to consolidation issues. To the best knowledge of the author, there is a lack of empirical studies relating growth with acquisitions, which makes difficult to state a generalization about the relation between growth and acquisitions. Nevertheless, there seems to exist a consensus among scholars that most of the acquisitions do not bring significant benefits to the acquirer, ending often in a divestiture (Kaplan & Weisbach, 1992).

2.3. Age

Along with size (addressed further), one of the most studied growth drivers is age. Age is supported by scholars to affect growth by several reasons. Age can be associated with a process of learning that firms experience within a specific industry. Jovanovic (1982) argues that firms' knowledge about how to be more efficient depend mainly on the time length they operate in a specific industry, and such efficiency will be translated into growth. Basically, in the beginning of the activity, firms face a significant uncertainty regarding operational efficiency issues (i.e. input versus output), uncertainty which is reduced year over year due to

firms' ability to interpret profitability at the end of each year. Admitting that young firms' uncertainty is higher than larger firms, yearly learning benefits are also higher when comparing to the rest of the firms: supporting the idea that younger firms will grow larger. This is the so called passive learning framework (Das, 1995; Jovanovic, 1982). The active learning framework, introduced in (Pakes & Ericson, 1998), goes against the passive learning framework, since it suggests that firms' efficiency depend on their levels of investment (e.g. in R&D). Nevertheless, based on mathematical evidences, this framework also predicts higher growth rates for younger firms. Additionally, older firms can also be less able to adapt to disruptive changes in the industry, due to a lack of an entrepreneurial spirit, among other factors, hindering their growth (Coad, 2007a).

On the other side, conceptually, there are also reasons to believe that age is positively correlated with growth. For example, age can imply higher reputation and credibility of a firm in an industry, fostering older firms' growth (Coad, 2007a).

Concerning empirical studies, despite some exceptions - see e.g. (Das, 1995) -, most of them support a negative relationship between growth and age, as suggested by the passive and active learning frameworks. For example, in (Evans, 1987a), for a set of small manufacturing firms over the period 1976-82[1]; in (Dunne & Hughes, 1994), for unquoted UK companies over the period 1975-85; in (Geroski & Gugler, 2004), for firms with more than 100 employees over the period 1994-98 and across 14 European countries; among others.

2.4. Diversification

Diversification is another factor that can have an impact on firms' growth. Diversification can have slightly different meanings across the literature. According to Ramanujam and Varadarajan (1989), common ways to define diversification concern the extent to which a specific firm has activities in a different number of industries or the extent to which a firm entered in new markets with new products.

To the best knowledge of the author, there is no conceptual contribution analyzing specifically the relation growth-diversification. Nevertheless, diversification can imply several benefits. For example, from a Market-power point of view, diversification allow firms to: engage on cross-subsidization schemes, in which profits from a specific business are used to support pricing strategies of another business; reduce the level of competition since, often,

[1] Despite not using data of large firms, this study is one of the most cited works concerning age-growth relationship.

conglomerates that compete with each others in several industries tend to compete less fiercely among them; engage on reciprocal buying among a network of large conglomerates, increasing growth obstacles to smaller firms (Montgomery, 1994).

On the other side, diversification can also have negative effects on growth. For example, Coad (2007a) states that diversification can be negatively correlated with growth since highly diversified firms are more likely to engage on activities within low-growth industries. Highly diversified firms can also be unable to transfer their competencies to different industries, resulting in lower growth rates (Geroski & Gugler, 2004).

Concerning empirical studies, there is still a reduced number of works addressing the relation growth-diversification (it is more common works analyzing performance-diversification). Nevertheless, Berry (1971) analyzed the 460 largest US manufacturing firms over the period 1960-65. As interesting finding was stated: relationship between growth and diversification was found to be negative when firms engaged on unrelated diversification (i.e. diversification towards significantly different industries); and found to be positive when diversification was done towards related industries. However, later, Jacquemin and Berry (1979), for the same data and with a developed metric to measure diversification, found that both types of diversification foster firms' growth. More recently, Geroski and Gugler (2004) analyzed the relation growth-diversification for a sample of firms with more than 100 employees across 14 European countries. Diversification was found to be generally negatively correlated with growth, only fostering large firms' growth.

To the best knowledge of the author, the relation between growth and diversification is clearly under-developed when comparing to diversification-performance (e.g. profitability). Henceforth, it is difficult to establish a concrete relation between diversification effect on growth.

2.5. Exports

Exports is another important issue to analyze within firm growth literature review. While several scholars analyzed the relation between exports and performance metrics, such as productivity and profitability, some authors approached the export-growth relationship and with more coherent results. Exports open new growth opportunities for firms, not only because they imply access to new markets, but also because they develop firms' competitive advantages. To be more concrete, exporters, against non-exporters, are submitted to an intense learning process, obliged to improve their products and processes due to the highly competitive environment of international markets. Additionally, this learning process can be

fostered not only by the contact with international competitors, but also with international suppliers and customers (Fryges, 2004). This idea can be called by the "learning by exporting" hypothesis (Fryges, 2004). Because of this, some scholars tend to believe that exporters will outperform domestic counterparts in terms of growth (Bernard & Jensen, 1999).

On the other side, there are also reasons supporting a possible negative correlation between growth and exportations. For example, such international activity increases the failure probability, which can have a negative impact on firms' growth (Bernard & Jensen, 1999). Wagner (1995) also argues that exports involves additional costs and managerial complexity, which can affect firm's results.

While for export-performance relationship several empirical studies have been showing different results, for export-growth relationship most of the findings support the idea that exporters are more able to grow at higher rates. Bernard and Jensen (1999) studied the export-growth relationship based on plant-level data over the period 1984-92. One of the difficulties of studying such relationship is to distinguish if exports are indeed affecting firms' growth or if firms that grew more are more likely to export (or both). Nevertheless, findings supported both previous affirmations. Thus, exportations were considered a growth driver. Fryges (2004) analyzed data of 600 technology-based firms in Germany and UK over the period 1997-98. Again, the findings support exportations as a growth driver. Based on an extensive data of 4000 firms across 54 countries, Beck, Demirgüç-Kunt, and Maksimovic (2005) also suggest that exports are a growth driver. Finally, Wagner (1995), analyzing the manufacturing industry in Germany for 1978 to 1989, also supported a positive correlation between exports and growth.

2.6. Innovation

In the midst of all growth drivers, innovation has been one of the most addressed by scholars. Smolny (1998) makes a clear distinction between product and process innovations. Product innovations, either a new product or the development of an existent one, not only increase demand and subsequently firm's sale, but also can reduce price elasticity due to a higher differentiation or quality, allowing a firm to increase prices and, eventually, augment sales. Concerning process innovations, they can also increase firm's growth and contribute to growth. One clear example is a process innovation that results in higher labor productivity, allowing to decrease costs and prices, fostering sales growth. Geroski and Machin (1992, 2013) complements this approach, stating that innovations are not the unique aspect

impacting firms' growth, but also the innovation process itself. This is because firms engaging on the process of converting scientific knowledge into new products and services are more likely to develop their internal capabilities, affecting how such firms generate growth, and distinguishing them among the competition.

Concerning empirical studies, several studies identified a strong statistical relation between innovation, usually measured by R&D expenditures, R&D intensity, number of patents or research employment, and firms' growth. Mansfield (1962) showed that successful innovative firms in US petroleum refining and steel industries are expected to grow at double rates when comparing to the rest of comparable firms in the same industry. Also for US, Scherer (1965) studied a large group of firms stated in the Fortune's list of the largest industrial firms in 1955. The number of patents and sales growth were suggested to be positively correlated with growth. Mowery (1983) studied the pre-World War II period with a sample of US manufacturing firms. Between 1933 and 1946, statistical results showed a positive correlation between growth and research employment. Also for US manufacturing firms, Hall (1987) found that R&D expenditures are an important predictor of firms growth. Doms, Dunne, and Roberts (1995) studied this issue concerning US manufacturing plants. The use of advanced technology was identified as a factor correlated not only with plant's growth but also with its survival probabilities. In resume, a significant number of empirical studies support the idea that innovation is a growth driver. For more empirical studies, please see (Cucculelli & Ermini, 2012[1]; Greenhalgh, Longland, & Bosworth, 1999).

However, some studies struggled with finding a positive relation between innovation and corporate growth. For example, Geroski (1995), based on a data base concerning 440 UK firms over the period 1972-1982, found no significant relation between innovation, measured by the number of patents, and firms' growth. Bottazzi, Dosi, Lippi, Pammolli, and Riccaboni (2001) studied the top 150 pharmaceutical firms in the world, and found no statistical correlation between the generation of new chemical entities and the patent intensity[2] and growth.

Despite some conflicts, some scholars affirm that most of the literature supports the idea that innovation is a growth driver (Del Monte & Papagni, 2003). The difficulties in relating growth and innovation can be caused by several aspects. First, there is a delay between innovation-related activities and impact on firm's growth. For example, a delay between R&D

[1] For data enclosing SMEs.

[2] Percentage of patented products among the whole portfolio.

investments and impact on growth is recognized by scholars (García-Manjón & Romero-Merino, 2012). This can be due to several reasons. Many times R&D investments give origin to new ideas or improvements of current products/processes that imply further engagement on R&D activities (Bloom & Van Reenen, 2002). Firms can also have the interest to protect intellectual property derived from R&D activities, incurring in time-consuming patent processes. Even when there are reasons to explore such innovation in a short term period, firms often have to translate findings into new capital equipment and engage on training, marketing and advertising activities (Bloom & Van Reenen, 2002). Such variety of contexts decrease the reliability of statistical studies: not because authors do not take into consideration such lag periods in statistical models, but mainly because lag length can vary across firms. Another possible reason for conflicts between different empirical studies is that innovation metrics are not valuable *per se*. For example, the level of R&D expenditures do not mean necessarily firms' level of innovation. Due to, e.g., lack of a link between R&D findings and customers' needs, R&D expenditures may not impact sales growth. Moreover, firms can also pursue innovation through other paths, such as with acquisitions of innovative and smaller firms. Finally, conflicts between empirical studies can also be partially explained due to differences between countries and sectors. To address such matter, García-Manjón and Romero-Merino (2012) used an extensive database concerning 1000 European firms with the highest R&D expenditures levels during 2003-2007. The main conclusions were in line with the general literature trend, so supporting innovation as a growth driver. However, the authors suggested that such affirmation can only be strongly generalized for firms in high-technological industries. For less technology-driven industries, the benefits of R&D expenditures are not clear.

2.7. Macro-Economic Factors

Some scholars also studied the relation between firms' growth and some macro-economic factors. For example, Beck et al. (2005), using an extensive dataset with 4000 firms from 54 countries, found that problematic financial and legal systems and corruption were negatively related with firms' growth. Additionally, firms in faster-growing countries (in terms of GDP) were found to grow at higher rates. In line with this, Geroski (1996), for the UK manufacturing firms, also found a significant correlation between the growth of industry sales and firms' growth. Reichstein and Dahl (2004), using Danish firm data, also compared two macro-economic factors with firms' growth. The first is related with industry concentration of a specific location. The goal is to measure to what extent a specific geographical area is

specialized in an industry, which may result in qualified labor, access to high levels of demand, among others. The second is related with the market structure concentration, to measure the level of competitiveness of a specific industry in a specific location, which is usually related with innovation levels that could support firms' growth. Both issues were found to be correlated with firms' growth.

2.8. Networks

Being part of a network is also argued by scholars to support and enhance firms' growth. Firms, when part of a network, can benefit from several advantages that support wealth creation (Stuart, 2000). Being part of a network allow to: unify complementary assets from different firms, creating synergies; share risk in highly costly or uncertain projects; increase market power; benefit from learning experiences of strategic partners, through the acquisition of know-how and new capabilities (Powell, Koput, & Smith-doerr, 1996; Stuart, 2000); among others. On the other side, as expected, networks can also have negative effects. For example, they can lead opportunistic behaviors of some strategic partners. Networks also require a significant focus of firm's management (Stuart, 2000), with the risk of losing control of already existent operations.

Regarding empirical studies, the majority of the recent literature is oriented to analyze specific features of partners and their relation with growth. For example, Stuart (2000) studied the relation between networks and growth regarding the semiconductor industry. In this context, authors found a positive relation between firms' growth and the size and innovation level of its strategic partners. While size is inextricably linked with access to resources and knowledge, innovative partners can foster reputation of a firm within the industry. In line with this, Niosi (2003), while studying biotechnology firms, found a significant correlation between firms' growth and the size of its corporate partners. For firms with universities and Government laboratories as partners, no statistical correlation was found. Also for the biotechnology industry, Powell et al. (1996) analyzed the impact of networks on growth taking into account features of the own firm (rather than its partners). Based on an empirical study, the authors suggested a positive relationship between firm's degree of centrality[1] and experience on being part of a network.

In conclusion, being part of a network is usually supported as a growth driver. However, such impact on growth does not depend on the number of partnerships or on the fact of being

[1] Centrality measures to which extent a firm is well connected or active within a network.

affiliated (Stuart, 2000). The key success factors regards partners' features, such as their size, and firms' internal capabilities to cope with challenges implied by being part of a network, which can be developed with firm's experience on this matter.

2.9. Ownership Structure

This chapter is devoted to a brief literature review concerning ownership structure. Most of scholars analyzed ownership and its impact on firm performance metrics (such as profitability and market capitalization). Nevertheless, as it will be shown, ownership structure can have an impact on firms' growth. Ownership structure literature is mainly divided into the three dimensions: *i)* ownership concentration; *ii)* managerial share-ownership; *iii)* owner identity (see e.g. Pinto, Augusto, & Gama, 2013[1]; Pedersen & Steen, 2003). Here, the focus is on the first two dimensions since, as it will be stated, they can impact not only firm's performance, but also growth.

Ownership-performance relation was firstly addressed by Berle and Means, and is mainly based on the Agency theory. This theory states that interests of principals and agents, in this context owners and managers, respectively, will barely coincide (Fama & Jensen, 1983; Gedajlovic & Shapiro, 1998). This is supported by several scholars and for different reasons (Short, 2003). The main issue is that while shareholders seek profits, managers will naturally tend to engage on non efficient activities, e.g. pursuing over diversification of business segments and growth above firm's optimal size for own utility. This is mainly because growth is usually related with higher bonuses, promotions, among others. Additionally, managers can also pursue an expansionary policy, building a highly diversified firm in order to spread risk and improve their personal performance as managers (Montgomery, 1994). So, in short, managers are more oriented to growth, while shareholders to firm's performance (e.g. profitability).

One way to cope with this is through monitoring (Gedajlovic & Shapiro, 1998). This is why ownership concentration is a critical aspect in this literature. Ownership concentration represents the extent to which a firm is held by a set of major shareholders (e.g., one can measure ownership concentration through the sum of equity percentages held by shareholders with more than 5% of the firm). Establishing the link between ownership concentration and monitoring, only firms with a high ownership concentration, i.e. with a relatively low number of shareholders holding a significant part of firm's equity, will be governed by shareholders

[1] Note that this work is more oriented to SMEs.

with sufficient incentive and power to monitor managers. Thus, ownership concentration is expected to be positively correlated with firm's performance (Gedajlovic & Shapiro, 1998) and, eventually, negatively correlated with growth.

Numerous empirical studies proved this relation. Gedajlovic and Shapiro (1998) analyzed a data set of firms in five countries (US, UK, Germany, France and Canada). Ownership concentration was found to be usually correlated with firm's performance (measured by profitability)[1]. Pedersen and Steen (2003) studied this relation, but measuring firm's performance with market-to-book value of equity. For firms mainly held by financial institutions or another corporations, statistical studies suggested a positive impact of ownership concentration on firm's performance.

Nevertheless, conceptually, this positive relation between concentration and performance was challenged. Ownership concentration has also prejudicial consequences, such as conflicts between controlling and minority shareholders, leading to lower performances (Morck, Shleifer, & Vishny, 1988). In fact, Morck et al. (1988) argued that such impact is more significant than the costs coming from the owner-manager conflict. Hence, in this point of view, it is expected lower performances with high ownership concentration. Finally, some scholars support the idea that ownership concentration should be treated as endogenous (Demsetz & Villalonga, 2001). Shareholders seek profits - so, ownership concentration increases or decreases according to firm performance. In other words, performance affect ownership structure and not the opposite.

As in the conceptual field, empirical approaches found different results. As already stated, some scholars found a linear positive relationship between concentration and performance; others found a linear negative relation - see e.g. (Mudambi & Nicosia, 1998) for UK financial services industry and (Leech & Leahy, 1991) for UK-listed firms; others found no significant statistical correlation - see e.g. (Himmelberg, Hubbard, & Palia, 1999) for a random sample of 600 firms and (Demsetz & Villalonga, 2001) for a random sample of firms from US economy; while others found non-linear relationships, such as in (Thomsen & Pedersen, 2000). Taking into account the most relevant works from the literature review, many scholars agree on the fact that the relation between ownership and firm performance is far from being established (Pedersen & Steen, 2003).

Concerning the second dimension of this literature, Jensen and Meckling (1976) argued that managerial share-ownership would help aligning managers' interests with shareholders'

[1] Nevertheless, some variations were noticed across countries.

interests. So, increasing managerial share-ownership can reduce the impact of manager-owner conflicts, fostering a convergence of interests (*convergence interest hypothesis*): i.e., managers would seek more intensely profitability rather than growth. On the other side, and denominated as *entrenchment hypothesis*, high levels of managerial share-ownership are also suggested to have negative consequences (Fama & Jensen, 1983). For example, managers holding a major part of firm's equity may have a significant influence to ensure his/her employment with high benefits (Morck et al., 1988).

In this context, and concerning empirical approaches, Morck et al. (1988) found a piece-wise linear relationship between firm performance and managerial share-ownership, increasing from 0 to 5%; decreasing between 5-25%; and increasing from values above 25%. This finding goes in line with the trade-off between *convergence interest hypothesis* and *entrenchment hypothesis*. For low levels of managerial share-ownership, there is a convergence of interests, increasing firm's performance. For intermediate levels, managers have more power over the firm, which can allow them to benefit more as managers instead of as shareholders, often conflicting with shareholders' goals and decreasing firm's performance. Finally, for high levels of managerial-share ownership, managers will benefit more with an increase of firm's performance, aligning their interests with stakeholders' interests (Pinto, et. al., 2013). This piece-wise linear relationship is supported by most of the literature. However, the values of the inflection points differ from work to work (Mudambi & Nicosia, 1998; Pinto, et al., 2013).

In conclusion, ownership structure is mainly analyzed in the light of its impacts on firm profitability, rather than growth. Nevertheless, this is important for this literature review since, depending on ownership structure, a specific firm can be more oriented to growth rather than profitability. In a simple way, the main highlight is that, when managers have more power (due to a lower ownership concentration or because managers are shareholders of the firm), firms are suggested to grow at higher rates but, sometimes, in exchange of firm's performance.

2.10. Profitability

Firms' profitability is another popular growth driver analyzed by scholars. Conceptually, it is clear a divergence between scholars concerning growth-profit relation. On the one hand, some authors support that profitability fosters growth. This is mainly due to two reasons (Lee, 2014). The first reason is that profitability fosters firms' expansion. For example, Lee (2014) argues that profits provide the means for new investment and growth, opening new financing

opportunities from retained profits or from the capital market. Myers and Maijluf (1984) complements this approach stating that firms have a preference for internal (rather than external) finance for their investments due to asymmetric information. So, retained earnings will more likely lead to new investments and expansions. The second reason concerns the inverse relationship: growth can also foster profitability. Different theories support this idea (Coad, 2007b). Concerning the classical economic theory, the Static Approach analyzes this relation in the light of the concept of "increasing returns". More specifically, growth will allow firms to exploit economies of scale increasing firms' efficiency and, by consequence, profitability. Resource-based view also suggests that growth can increase profitability levels: e.g., increasing firm's activity and the utilization rate of underutilized assets. The Dynamic Approach suggests that firms with high growth rates are more likely to invest on innovation concerning production processes, increasing their profitability due to higher efficiency. Moreover, growth is also related with experience curve effects, which can augment productivity and profitability levels (Lee, 2014).

On the other hand, some scholars interpret this relationship as a trade-off. For example, Penrose (1959) argues that managers are more oriented to exploit new businesses, for own benefit, losing the focus on operational efficiency[1] (Lee, 2014). Even in the presence of profit oriented managers, growth will be despised to maintain high levels of profitability (Lee, 2014). Arbaugh and Camp (2000) suggest that growth will entail a higher organizational complexity and, so, lower operational efficiency and profitability levels (Lee, 2014). Steffens, Davidsson, and Fitzsimmons (2009) state that firms will first engage on profitable businesses (Lee, 2014). As a consequence, at a given time, growth implies the selection of less profitable businesses. Concluding, conceptually, scholars have opposite views about the relation between growth and profitability.

Concerning empirical studies, findings across literature are also not coherent. Few studies found a positive relation between profitability and growth. One example is in (Geroski, Machin & Walters, 1997), while studying 271 UK listed firms over the period 1976-82. In (Goddard, Molyneux, & Wilson, 2005), a significant positive relation between profits and future growth was also found, for data concerning 625 European banks over the period 1992-98.

On the other side, different authors found that profitability can have a negative impact on growth. Using an extensive sample, with more than 2000 UK firms from 24 industries for the

[1] Remember also previous chapter.

period between 1960 and 1974, Whittington (1980) found a negative correlation between profitability and growth. Hardwick and Adams (1999) used data over the periods 1987-91 and 1992-96, regarding 231 UK life insurance companies. In line with the previous work, the panel data model results showed a negative relation between profitability and growth.

Finally, some empirical studies also suggest independence between growth and profitability. In (Bottazzi & Secchi, 2007), based on data concerning Italian firms from manufacturing and services industries over the period 1998-2003, profitability levels were not found to yield any different capability to grow. In (Coad, 2007b), analyzing French manufacturing firms over the period 1996-2004, the authors also suggested that growth is independent from profitability.

In conclusion, the relation profit-growth was reviewed in the literature in a conceptual and empirically way. To the best knowledge of the author, the relation between profit and growth is far from being completely understood. Lee (2014) suggests that different results between scholars are mainly due to different econometric and sample selection issues.

2.11. Productivity

Productivity, highly correlated with profitability, is another growth driver addressed in the literature. Labor productivity and capital productivity are among the most common and simple metrics used to quantify productivity. High levels of productivity can be achieved due to several reasons, such as higher technical capabilities, innovation abilities, superior managerial routines, among others (Bottazzi, Secchi, & Tamagni, 2008). Two main conceptual approaches support the idea that productivity fosters growth. The first one is related with the passive learning model (Jovanovic, 1982), as already addressed previously. This approach suggests that firms, year over year, learn about their efficiency (i.e. productivity) and how to improve it. In this context, Jovanovic (1982), based on mathematical evidences, suggests that more efficient firms will tend to grow more. The second regards the Evolutionary Economic Theory, in which only the most efficient firms will survive and grow (Coad, 2007a). In short, in this theory, the economy is characterized by scarcity of resources. The pressure to efficiently allocate resources is high and, consequently, resources will be allocated on the most productive firms, allowing them to grow (Coad, 2007a). Moreover, as expected, since productivity is one possible path to profitability, productivity can foster growth in an indirect way (see Chapter 2.10.). Finally, productivity can be a means to offer products with lower prices and, subsequently, increase market shares (Bottazzi et. al., 2008). Conceptually, profitability can also be negatively related with growth. For example, some

firms can achieve higher productivity levels through downsizing operations (Bartelsman, Haltiwanger, & Baily, 1996).

Some empirical studies found evidences to support the idea that productivity fosters growth. For example, in (Liu, Tsou, & Hammitt, 1999), for plant-level data regarding the Taiwan electronics industry and over the period 1990-94, a significant positive correlation between labor productivity and growth was found. In line with this, Bigsten and Gebreeyesus (2007)[1] found similar results for data of the Ethiopian manufacturing industry from 1996 to 2003. Disney, Haskel, and Heden (2003) studied this issue in UK manufacturing between 1980 and 1992, and found that higher productivity is not only a means to grow faster, but also increases likelihood of survival.

However, not all empirical studies agree on this fact. In (Bottazzi, Cefis, & Dosi, 2002), based on data about Italian firms over 1989-96, the correlation between productivity and growth was not found to be robust, depending on the growth metric (it was used number of employees, sales and value added). Later, Bottazzi et al. (2008) analyzed an extensive set of Italian firms over the period 1996-2003, and only a very weak relation between productivity and growth was found.

In conclusion, it is difficult to establish a clear relation between growth and productivity. Bottazzi et al. (2008) suggests that, since productivity will "naturally" increase profitability, growth-productivity relationship will depend on managers' will to convert profitability into growth.

2.12. Firm's Size

Firm's size, usually measured by sales or number of employees, is probably the most popular growth driver within firm growth literature. One of the first works studying the effects of firm's size on growth was introduced in (Gibrat, 1931), in which the Gibrat's Law is stated. This Law supports the idea that growth is a random process and, so, it is independent from firm's size. Most of the literature relating growth and size are focused on testing the Gibrat's Law. Note that this law can be tested by two approaches: *i)* a more conceptual one, based on evaluating the plausibility of the mathematical assumptions behind Gibrat's Law; *ii)* a more practical one, based on statistical studies to estimate the correlation between size and growth average (Ijiri & Simon, 1964). This brief review is mainly focused on the second approach, enclosing empirical studies that test the Gibrat's Law.

[1] Note that this work's data base encloses mainly small firms.

Several empirical studies found statistical evidence to support Gibrat's Law; see e.g. (Hart & Prais, 1956), (Simon & Bonini, 1958) and (Hymer & Pashigian, 1962). In a short way, this law supports the independence between firm's size and its growth. In (Mansfield, 1962), a concrete example is given - *"a firm with sales of $100 million is as likely to double in size during a given period as a firm with sales of $100 thousand"*.

Within this context, Mansfield (1962) performed an empirical study for three scenarios: *i)* including all the firms; *ii)* including only firms that survived along a specific period of years; *iii)* including only firms that survived and that exceed a minimum efficient size in the industry ("the size below which unit costs rise sharply and above which they vary only slightly"). For the first two scenarios, Gibrat's Law was rejected since smaller firms were noticed to be more likely to leave the industry, and those that survive have higher growth rates when comparing to larger firms. For the third scenario, the results were in line with Gibrat's Law. This distinction was a significant contribution for the literature - *a posteriori*, several studies were more rigorous on data treatment (Sutton, 1997). In fact, most of the subsequent studies analyzed growth-size relation only considering surviving firms.

Later studies conflicted with Gibrat's Law, showing that larger firms have faster growing rates. For example, in (Samuels, 1965), based on an analysis of roughly 2000 UK quoted companies from 21 industries; later, in (Singh & Whittington, 1975), based on 400 companies from the commercial, industrial and brewery sections of the Stock Exchange Year Book

Against these studies, most of empirical analysis supported a negative relation between size and growth. Kumar (1985) presented the first work studying the period between 1960 and 1976 with a significant extensive sample of UK quoted firms. The findings support a negative correlation between growth and firm for manufacturing and non-manufacturing industries. The same relation was found in Evans (1987b) and (Hall, 1987).

Besides these conflicts, some scholars denoted that growth and size relation depend on the temporal period. Dunne and Hughes (1994) examined quoted and unquoted firms from UK, with larger firms growing faster in the 1960s *versus* smaller firms growing faster in the 1980s. This suggests that the relationship between size and firm growth is mediated by the time (Reichstein & Dahl, 2004).

Despite all this ambiguity, the general trend across industries is characterized by a negative correlation between size and growth (Sutton, 1997). One can state that Gibrat's Law is respected only when considering large firms; while for smaller firms, the growth rates are negatively related with the size (Caves, 1998). To resume, in (Lotti, Vivarelli, & Santarelli, 2003), the following affirmation is stated.

"Gibrat's Law of Proportionate Effect exhibits a behavior which depends on the life cycle of the firm. In effect, for six of the seven industries examined, the Law fails to hold during the first year(s) following start-up - when smaller entrants grow faster than their larger counterparts - whereas it becomes acceptable once a minimum threshold in terms of size and age has been reached."

This negative relation between size and growth below a minimum threshold was supported by several recent works, such as in (Geroski & Gugler, 2004) and (Bigsten & Gebreeyesus, 2007). For a detailed survey, the reader is referred to (Santarelli, Thurik, & Klomp, 2004).

2.13. Conclusion

This part was devoted to a brief literature review concerning growth drivers. In the end, it was possible to understand the existence of eleven important growth drivers: *i)* acquisitions; *ii)* age; *iii)* diversification; *iv)* exports; *v)* innovation; *vi)* macro-economic factors; *vii)* networks; *viii)* ownership structure; *ix)* profitability; *x)* productivity; *xi)* size. The main highlight of the literature is that for each growth driver there are conceptual and empirical conflicts. In other words, some scholars argue that a specific growth driver has a positive impact on growth, while others suggest a negative impact. Concerning a smaller set of growth drivers, there are also scholars arguing that growth is independent from those growth drivers. On the empirical side, there are also clear conflicts concerning growth drivers' impact on growth.

In this context, this literature review provided two main outcomes. The first outcome is a list of eleven growth drivers. The second outcome concerns the conclusion that each growth driver should be tested for the specific case study of this thesis. The goal is simply to understand if a specific growth driver impacted growth of the firms under analysis. Given these two outcomes, Part 3 is devoted to explain the methodology to analyze growth of the selected firms.

3. Methodology

3.1. Introduction

Given the list of growth drivers, this part will present the methodology to analyze growth of the Belgian firms, which is based on two steps. First, Chapter 3.2. presents the basilar feature of the methodology. In short, a comparative analysis will be performed between the Belgian firms and two benchmarks, namely BASF and The Dow Chemical Company. Based on such comparison, two groups of firms will be defined according to their growth. The first group, the one that grew more intensely over the period 2002-13, is comprised by BASF, Floridienne and The Dow Chemical Company; the second group, with lower sales growth, is comprised by Sioen Industries, Solvay, Tessenderlo, Recticel and Agfa-Gevaert. Second, Chapter 3.3. is oriented to define the methodology to understand why the first group grew significantly more than the second group, over the period 2002-13.

3.2. Comparative Analysis and Objective

As stated in Part 1, the main intent of this thesis is to analyze sales growth of the selected Belgian firms in the Chemical Industry. In order to do so, a first meeting was held on 17th March 2015 with Mr. Cornélis with the intention of understanding what should be the appropriated methodology. The main outcome of such meeting (Annex 1) was the decision to analyze sales growth of the Belgian firms in the light of the sales growth of two firms: BASF and The Dow Chemical Company. In other words, to perform a comparative analysis between the Belgian firms and those two firms. BASF and The Dow Chemical Company are two of the most well-regarded chemical firms in the world (see Annex 2 for a brief presentation of the firms). The goal is to compare Belgian firms' sales growth with two firms that can be considered as worldwide benchmarks within the chemical industry. Henceforth, while there are plenty of methodologies to analyze sales growth, the selected one provides a perspective that analyzes Belgian firms' growth in light of two outstanding models of the chemical industry.

In this context, one should perform a comparative analysis between BASF and The Dow Chemical Company and the rest of the Belgian firms. For this, sales growth of the firms under analysis were collected. Since data bases usually present some missing values or not restated values, data collection was based on firms' annual and financial reports. Finally, The Dow Chemical Company's sales were converted from USD Dollars to Euros according to the

closing exchange rates of each specific year (Xe.com, 2015). Figure 3 presents firms' sales as percentage of sales in 2002 and over the period 2002-13.

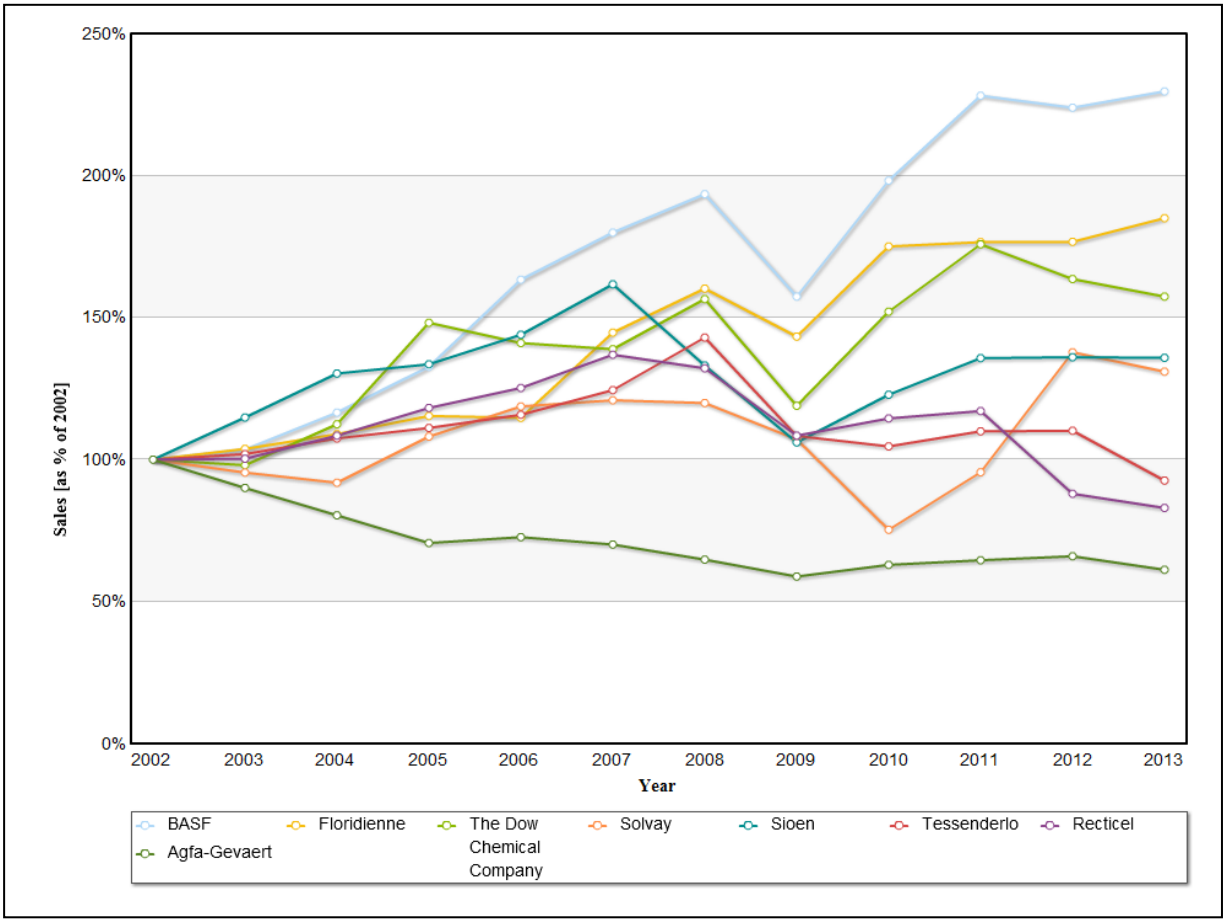

Figure 3 Firms' Sales (%) Relative to Sales in 2002 Over the Period 2002-2013 **Source** The Author based on BASF's, Floridienne's, The Dow Chemical Company's, Solvay's, Sioen's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports

While analyzing Figure 3, the following remarks may be done:

i) BASF and The Dow Chemical Company (benchmarks) present a higher growth comparing to the rest of the firms over the period 2002-13, excepting Floridienne;

ii) BASF, Floridienne, The Dow Chemical Company, Sioen Industries and Solvay present a positive growth over the period 2002-13, while Tessenderlo, Recticel and Agfa-Gevaert present a negative growth;

iii) all firms present yearly negative growth rates in 2008-09, most likely due to the financial crisis in 2008 (CEFIC, 2014).

At this time, it is possible to understand that one of the benchmarks, i.e. The Dow Chemical Company, is outpaced by Floridienne in terms of sales growth. For this reason, and for the comparative analysis, one can include Floridienne as a benchmark, since there is a clear difference between BASF, Floridienne and The Dow Chemical Company and the rest of the firms. Henceforth, the growth analysis of this thesis will be based on the following problematic: "Why did BASF, Floridienne and The Dow Chemical Company outgrow Sioen, Solvay, Tessenderlo, Recticel and Agfa-Gevaert over the period 2002-13?".

Given the sales growth overview, a more quantitative approach, rather than visual, should be performed in order to better justify the problematic of this thesis. The objective is to understand to which extent BASF, Floridienne and The Dow Chemical Company outgrew the rest of the firms. In other words, one should justify that there is a significant difference between benchmarks' growth and rest of the firms' growth, otherwise it does not make sense to perform a comparative analysis between these two distinct groups. In order to do this, Figure 4 presents sales CAGR of the selected firms over the period 2002-13. Additionally, sales CAGR of the Chemical Industry in Europe (EU) and in United States of America (USA) are presented in order to establish reference levels.

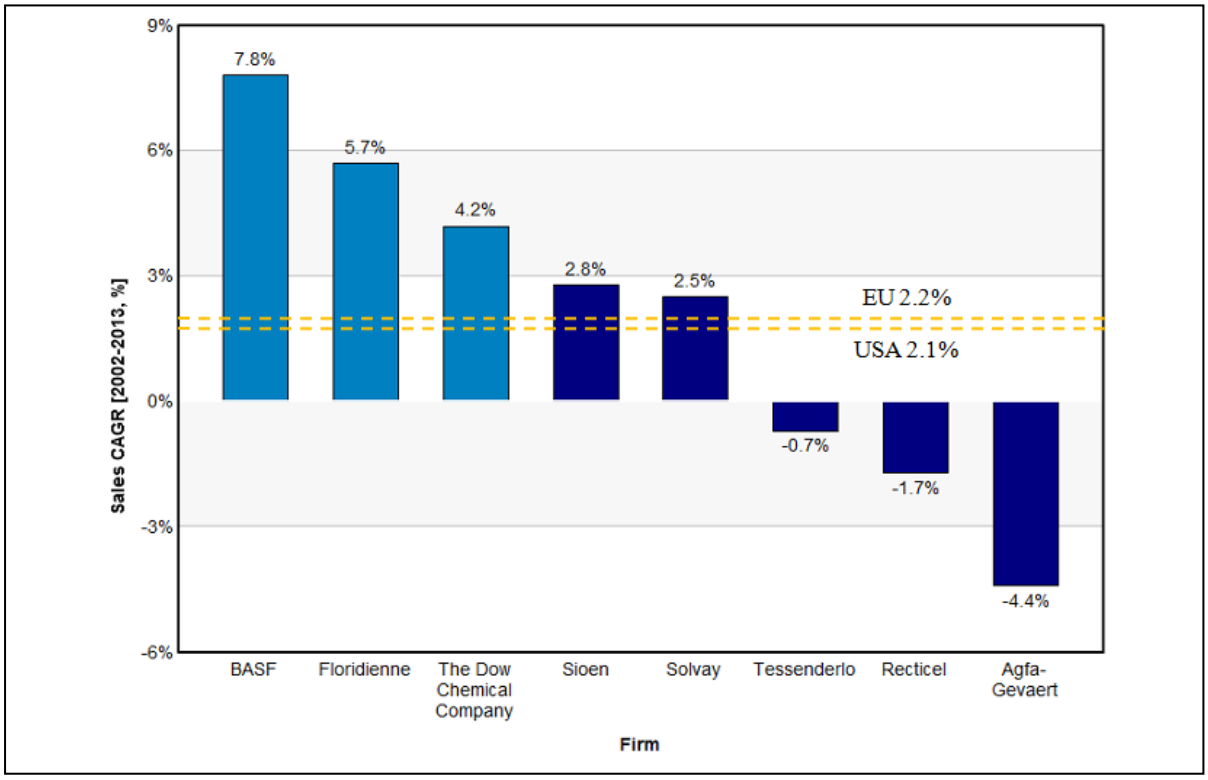

Figure 4 Sales CAGR [2002-13] of the Selected Firms *vs* Sales CAGR of the Chemical Industry in Europe (EU) and United States of America (USA) **Source** The Author based on BASF's, Floridienne's, The Dow Chemical Company's, Solvay's, Sioen's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports, CEFIC (2014) and (United States Census Bureau (2015)

In general, it is clear that BASF, Floridienne and The Dow Chemical Company grew significantly more than the rest of the firms. However, is it plausible to consider only these firms as benchmarks? Since The Dow Chemical Company is establishing the threshold between benchmarks and rest of the firms, should this firm be excluded from the group of benchmarks? Or, on the reverse side, should Sioen Industries be included in the group of benchmarks?

In order to address these questions, one can compare firms' growth with its domestic chemical industry's growth. Note that one can consider that The Dow Chemical Company's domestic chemical industry is in USA, and Sioen's in Europe, due to theirs sales distribution per geographical area (see Annex 2). In this context, it is reasonable to state that The Dow Chemical Company grew significantly more than Sioen Industries since, when comparing to the growth of the chemical industry in USA (2,1%), this firm grew at a double rate (4,2%); while Sioen grew +0.6% when comparing to its domestic market, which is an almost residual value when comparing to The Dow Chemical Company (+0,6% *vs* +2.1%, more than the triple). Concluding, the problematic addressed by the question "Why did BASF, Floridienne and The Dow Chemical Company outgrow Sioen, Solvay, Tessenderlo, Recticel and Agfa-Gevaert over the period 2002-13?" is not only verified, but growth differences between the two groups of firms are significant. Hence, it is assumed that is plausible to perform a comparative analysis between these two groups.

Given this, the overall objective of this thesis is precisely to answer the question that describes the problematic. In order to do this, and taking into account the growth drivers, this objective is divided into two sub-objectives:

i) Identify the growth drivers that, over the period 2002-13, had an impact on firms' growth;
ii) Identify the growth drivers that are distinguishing benchmarks from the rest of the firms.

These two sub-objectives allow to better address the problematic. Note that, to understand the reasons behind growth differences between benchmarks and rest of the firms, one should identify the growth drivers that not only impacted firms' growth (since, as studied in the literature review, growth drivers' impact on growth is not always verified[1]), but also that

[1] Note that growth drivers' impact on growth is usually measured by the correlation between these two variables (as it is clear, this is a limitation).

distinguish benchmarks from the rest of the firms (e.g., high/low levels of R&D intensity presented by benchmarks/rest of the firms). With this analysis, one can attempt to answer to the problematic. Chapter 3.3. presents the approach to achieve these two sub-objectives.

3.3. Approach Towards Sub-Objectives

This chapter is devoted to the explanation of the methodology to tackle this thesis's sub-objectives. First of all, note that such methodology will not be applied to all the eleven growth drivers identified in Part 2. This list of growth drivers was filtered for this specific case study, and the most relevant growth drivers were selected. In order to perform such selection, an interview was held with an expert of the industry (Annex 1). Among the eleven growth drivers identified in the literature, four were selected[1]. Taking into account these four growth drivers, this chapter presents the methodology that was used to *i)* identify the growth drivers that, over the period 2002-13, had an impact on firms' growth (Section 3.3.1.). Second, it is stated the methodology to *ii)* identify which are the growth drivers distinguishing benchmarks from the rest of the firms (Section 3.3.2.).

3.3.1. Identification of Growth Drivers that Impacted Firms' Growth

As it was possible to understand during the literature review, and stated clearly in its conclusion, the *Growth as an Outcome* literature is described by several conflicts between scholars concerning the impact on growth of each growth driver. Thus, there is a need to prove that a specific growth driver impacted firms' growth between 2002-13.

With this intent, the author followed a specific methodology taking into account the literature review. Most of the empirical studies within the *Growth as an Outcome* literature use panel data models (one specific type of linear models) to understand if there is a significant correlation between a specific factor and growth - please see, e.g., (Coad, 2007b; Goddard, Wilson, & Blandon, 2002). Such correlation, if positive and significant, suggests that a specific growth driver had an impact on growth over the period under analysis. The author highlights the word "suggests", since correlation does not imply causality (e.g. growth and the growth driver can be consequences of a common cause) [2].

[1] Part 4 addresses the selection of the relevant growth drivers for this case study.

[2] For one relevant growth driver, namely international activity (described further), a different methodology was employed - this issue will be addressed further.

Panel data models are not only very frequent in the literature, but also recognized as one of the richest parametric approaches to this problematic. In short, panel data consists on a linear model that takes into account data of multiple variables, concerning a set of individuals (in this case firms) and involving over time (in this case, over the period 2002-13). Moreover, despite the application of a similar methodology of the literature review, the ultimate goal is slightly different. Note that scholars use extensive data bases in order to use representative samples and generalize findings. In this thesis, the goal is not to generalize findings, i.e. prove that a specific growth drivers fosters growth. The goal is simply to understand if a specific growth driver fostered growth of the firms under analysis, without any form of generalization.

Concerning this statistical approach, three additional points should be stated. First, to identify the growth drivers that impacted firms' growth, each growth driver will be assessed in a separate way. In other words, a panel data model will be used to each growth driver (instead of just one model for all of them). This was done due to data availability issues. For example, while for one growth driver it was possible to collect data over the period 2002-13; for another one, only data from 2004 to 2013 was available. So, to avoid data losses, one panel data model is employed to each growth driver. Second, for the construction of the regression equation of the panel data, the author followed a specific well known work in the literature (one for each selected growth driver). Such work is cited before each regression equation. Third, for the estimation of the regression coefficients, two commonly used methods of panel estimation were used, namely fixed and random effects (Wooldrige, 2010). While fixed effects estimates take into account growth variations across time within a specific firm (tracking each firm over the period), random effects estimates include information not only across periods but across individuals (so, tracking each firm but also comparing them). There are several drawbacks and advantages of each estimation[1], but scholars usually recur to Hausman test to evaluate which model should be applied, see e.g. (Del Monte & Papagni, 2003). Thus, according to Hausman test, the author will decide which panel data estimation should be used.

3.3.2. Identification of Growth Drivers Distinguishing Benchmarks from Rest of the Firms

In order to understand what are the growth drivers that distinguish benchmarks from the rest of the firms, a simple quantitative analysis was performed: a comparative analysis between benchmarks and rest of the firms based on a specific metric related with each growth driver.

[1] For more details in this matter, please see (Wooldrige, 2010) - Part 10.

For example, firms' innovativeness is one of the selected growth drivers. One possible metric to quantify firm's innovativeness is R&D Intensity (i.e. R&D expenses per sales). Hence, the goal is to compare benchmarks' R&D Intensity with rest of the firms and try to perceive if the formers engaged less in R&D activities over the period 2002-13. Additionally, this comparison of growth drivers' metrics was analyzed with the support of an expert of the industry, during a meeting held on 30th April 2015 (Annex 3).

3.4. Conclusion

To conclude, the methodology is clearly separated to address each one of the two sub-objectives addressed in this thesis. Figure 5 presents a schematic resuming the methodology employed in this thesis.

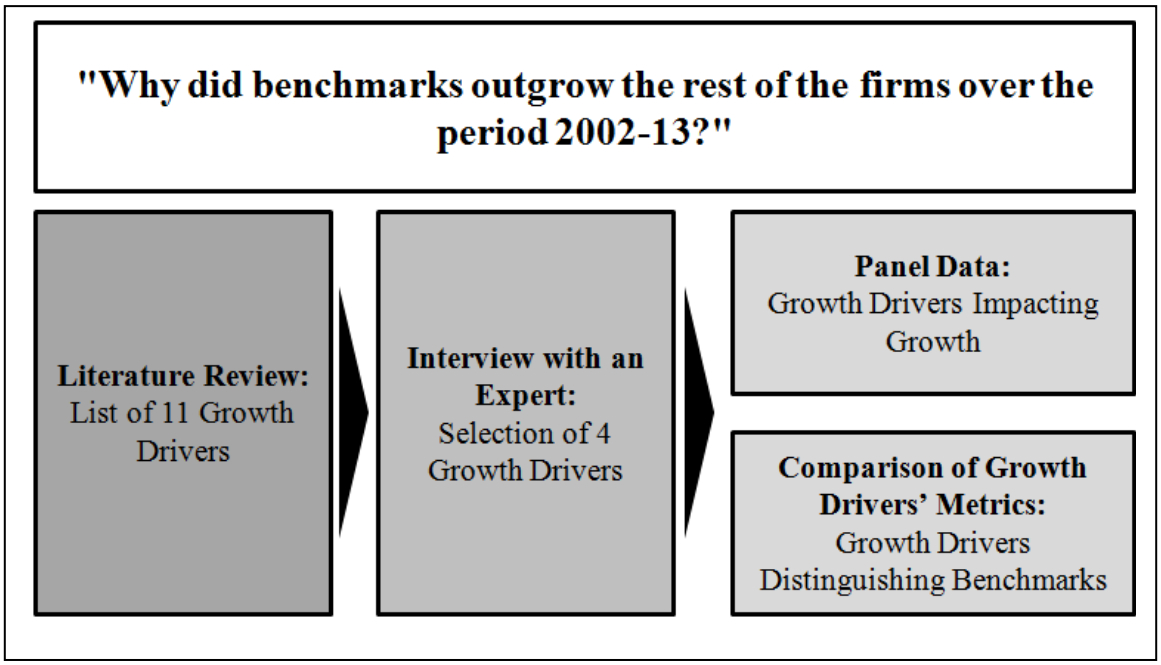

Figure 5 Methodology Used to Understand Growth Differences **Source** The Author

The following structure of the thesis is aligned with the methodology. Henceforth, Part 4 is dedicated to explain the selection of the four relevant growth drivers for this case study.

4. Selection of Growth Drivers

4.1. Introduction

As stated in Part 2, during the literature review the author identified mainly eleven growth drivers. In this context, this part is devoted to explain the selection process of the growth drivers that were considered to be relevant for this case study. In order to ensure the selection of the most relevant growth drivers, a meeting was held on 17th March 2015 with an expert of the chemical industry (please see Annex 1). The selected growth drivers are the following ones[1]: *i)* level of dividends; *ii)* firms' international activity; *iii)* innovation; *iv)* level of acquisitions. Level of dividends was not found in the literature as a growth driver. As it will be explained ahead, the reason to include dividends is linked with profitability (which is an identified growth driver): so, they will be studied together. Firms' international activity is related with macro-economic factors stated in the literature review. Finally, innovation and level of acquisitions are self-explanatory and directly related with the growth drivers identified in the literature. In this context, the following chapters are devoted to the explanation of the reasons behind the selection of each growth drivers.

4.2. Dividends

Concerning the first selected growth driver, dividends refer to the distribution of a portion of firm's earnings among its shareholders. This is a decision made by the board of directors in order to reward shareholders for their investment, and many times used as a means to foster shareholders' interest on firm. Given the definition, one should understand how dividends can impact growth. The reason to include the level of dividends is straightforward. As stated in the definition, dividends are part of firm's earnings in the end of year. When a firm has a positive net income, two main options can be considered: *i)* net income (or part of it) can be distributed as dividends to shareholders; *ii)* net income (or part of it) can be kept within firm's retained earnings. Retained earnings are accumulated year over year according to Eq. 1.

$$Retained\ Earnings\ (RE) = BeginningRE + Net\ Income - Dividends \qquad \text{Eq. 1}$$

[1] Ownership structure was also identified. However, the author was not able to find reliable data concerning ownership structure. Thus, such relevant growth driver was excluded.

In this context, dividends decrease the value of the retained earnings. In view of the fact that retained earnings are, often, used to invest on business areas to create growth opportunities, such as through acquiring a new chemical facility or investing on R&D, the level of dividends may have a significant impact on growth, since they can reduce such levels of investment.

However, note that what one wants to measure is not the level of dividends (because they do depend on profitability levels). Rather, one should measure the percentage of the net income that is allocated to dividends. This gives a perception of to which extent a firm is oriented to kept retained earnings and invest on the business. So, in this thesis dividends will be assumed as a growth driver (negatively correlated with growth), but measured according to the following equation (Eq. 2).

$$Dividend\ Payout\ Ratio(\%) = \frac{Dividends}{Net\ Income} * 100 \qquad \text{Eq. 2}$$

Dividend payout ratio (DPO) expresses the proportion of the net income that was allocated to pay dividends. Note also that, for the comparative analysis, this metric is suitable since it allows to compare firms with different profitability levels, providing a perception of which firms are more oriented to kept retained earnings rather than distributing it to shareholders. One main limitation can be pointed to this metric, since firms can kept net income and use it to, e.g., pay debt, instead of investing on the business and foster growth. However, the author believes that DPO is a plausible metric.

Additionally, note that DPO should not be analyzed alone. If one is trying to understand to which extent firms are investing in the business, profitability should also be included as a growth driver. In short, while the DPO expresses firms' will to invest; profitability expresses the means to invest. In fact, as it was analyzed during the literature review, one of the reasons to consider profitability as a growth driver is because higher profitability can support new investments and ensuing growth (Lee, 2014). In conclusion, DPO and profitability will be analyzed together: DPO is the proxy to measure firms' orientation to pay dividends rather than to invest on the business; profitability, to understand, regardless firms' orientation, if firms were been able to achieve sufficient profitability to invest on the business.

4.3. Firms' International Activity

As stated during the literature, some scholars found a positive relation between the economic activity of a specific industry or country and firms' growth. For example, Beck et al. (2005)

found that firms in faster-growing countries present higher growth rates. At an industry level, Geroski (1996) also found a significant correlation between the growth of industry sales and firms' growth. Henceforth, the main highlight of these works is that firms' growth can be significantly impacted by the economic dynamism surrounding them. Given the fact that Asia has been showing outstanding growth rates in terms of chemical sales (mainly in China), one should analyze firms' international activity to understand if benchmarks' growth, against rest of the firms' growth, is benefiting from growth in Asian chemical markets. This point is a must in a sales growth analysis concerning the chemical industry, as it will be justified further. For this, please see Figure 6.

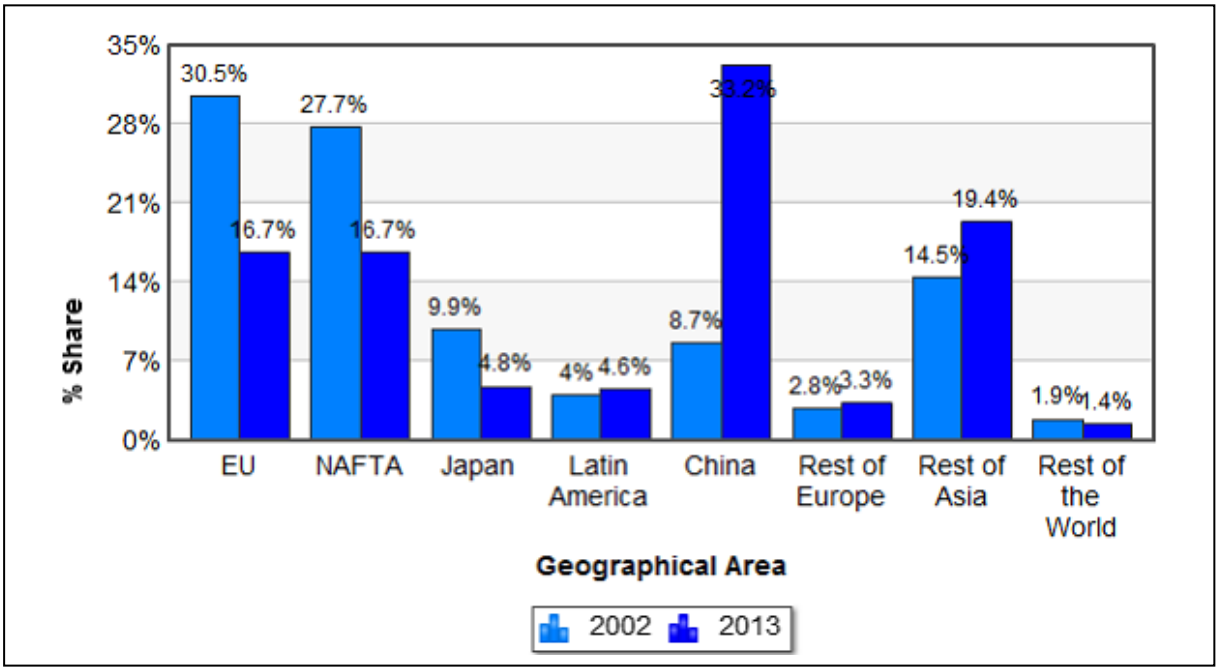

Figure 6 World Chemical Sales per Geographical Area (%) (*NAFTA=North American Free Trade Agreement; **Rest of Europe includes Switzerland, Norway, Turkey, Russia and Ukraine; ***Rest of Asia excludes China and Japan) **Source** The Author based on (CEFIC, 2013, 2014)

Since most of the firms are from Europe and with most of part of the sales in Europe (Annex 2), one should understand how the chemical European market evolved over the period 2002-13 *vis a vis* the Asian market. In fact, sales in European Union (EU) present a CAGR of 2.2% over the period 2002-13, and so one can affirm that European chemical industry is actually showing good results (CEFIC, 2013; 2014). However, given the worldwide competition, Europe has lost its position as the geographical area with the higher percentage of chemical sales in the world. As one can see in Figure 6, EU, in 2002, presented 30.5% of

the total chemical sales in the world. In 2013, such percentage suffered a significant decline to 16.7%. This trend is also similar for NAFTA. This is mainly due to the Asian markets, that increased its sales in an outstanding way. In fact, Asia nowadays represents more than the double of chemical sales in EU.

Within this context, it essential to consider firms' internationalization activity as a growth driver. Linking with the literature, maybe benchmarks are benefiting from the fast growing chemical industry in Asia. Thus, the goal is to try to understand what is the geographical area that driven most of the growth of the selected firms which, taking into account the last facts, is expected to be Asia.

4.4. Innovation

As already addressed, innovation can indeed foster growth. Innovation can be a means to create new segments of sales, through the introduction of new products; to increase sales due to the development of already existent products; innovation can also foster growth through the development of processes, enabling firms to, e.g., present products at higher competitive prices; finally, innovation is also a process that firms engage on and develop their internal capabilities and competitive advantages (Geroski & Machin, 1992, 2013; Smolny, 1998).

Nevertheless, the point is to understand if innovation is a relevant growth driver for this case study. According to (Garcia-Manjón & Romero-Merino, 2012), innovation (measured by R&D expenditures) is usually a growth driver, but innovation is even more relevant for technology-driven industries. So, the question is: is the chemical industry a technology-driven industry? One plausible way to answer to this question is based on R&D intensity of the industry. In fact, R&D intensity expresses the level of effort dedicated to innovation. In this context, according to (European Commission, 2013), in 2013, chemical industry presented 2% in terms of R&D intensity in European Union and 3.4% in USA. Concerning all the 40 analyzed industries, in Europe the chemical industry was among the top 13 industries with higher levels of R&D intensity, and top 7 in USA (with pharmaceutical industry leading both rankings). Thus, one can suggest that innovation is indeed a significant issue in the chemical industry *vis a vis* other industries. For this reason, innovation should be studied as a relevant growth driver for this case study.

4.5. Acquisitions

Concerning the fourth selected growth driver, (Delmar et al., 2003) states that acquisitions are a way of growing, along with organic growth and other hybrid growth modes (e.g. through

joint ventures, franchising). In this sense, acquisitions can be studied as a growth driver. Acquisitions may provide, in a faster way, new knowledge and resources that are needed for further growth in firm's current businesses. This is from a point of view of creation of synergies. In other words, from a point of view of acquisitions' impact in organic growth, as studied in (Lockett et al., 2007). Moreover, by definition, an acquisition of a subsidiary implies increasing parent company's revenues, resulting in additional growth. And, in fact, not all benefic acquisitions are oriented to create synergies (McKinsey & Company, 1996). So, acquisitions have two impacts on firms' growth: on the one hand, acquisitions can have effects in firms' organic growth; on the other hand, by definition, acquisitions increase firms' sales due to consolidation of a new firm within a holding.

This growth driver is indeed a relevant one since the set of firms under analysis of this case study engaged heavily on acquisitions. The next paragraphs are dedicated to justify this, stating the most significant acquisitions over the period 2003-2013. All the acquisitions with purchase prices[1] over 5% of firm's initial size (measured by the value of sales of the previous year to the acquisitions) were considered[2].

In 2006, BASF made its two biggest acquisitions in terms of purchase prices. First, acquired all outstanding shares of common stock of Engelhard Corporation. Engelhard Corporation was a US based supplier of goods for catalysis and surface finishing. The purchase price was of, roughly, EUR 3,956 Million. In the same year, BASF also acquired the construction chemicals business of Degussa AG, for a purchase price of EUR 2,200 Million. These two acquisitions represented nearly 14.5% of BASF's sales in 2005.

Regarding The Dow Chemical Company, its biggest acquisition was in 2008 when acquired Rohm And Haas Ltd, a specialty materials company. Purchase price was nearly EUR 11,544 Million, representing 32% of The Dow Chemical Company's sales in 2007.

Sioen Industries' main acquisition was in 2006 when acquired Group Richard Colorants, a manufacturer of colorants, for a purchase price of EUR 16 Million, representing 5.1% of Sioen Industries' sales in 2005.

In 2013, Solvay has agreed to acquire Chemlogics Group, an American company and developer and manufacturer of aroma and flavor chemicals. Total purchase price was EUR 888 Million, representing 8.1% of Solvay's sales in 2012. Solvay biggest acquisition was in 2011, when acquiring Rhodia SA, a listed France based international chemical firm. The

[1] Purchase price is defined in detail in Section 5.5.2.

[2] Data based on Mergermarket database, Zephyr database and firms' financial and annual reports.

acquisition price was of EUR 3,876 Million, representing nearly 65% of Solvay's sales in 2010. Finally, in 2005, Solvay acquired Fournier Pharma, a France based healthcare company. Total purchase price was of EUR 1,361 Million, representing 18.7% of Solvay's sales in 2004.

Agfa-Gevaert made its biggest acquisition, in terms of purchase price, in 2005. Agfa-Gevaert acquired GWI AG, a health-care IT technology provider. The total purchase price was EUR 350 Million, representing 9.3% of Agfa-Gevaert's sales in 2004.

Finally, concerning Floridienne, no such data is available (only aggregated purchase prices). Regarding Tessenderlo and Recticel, no significant acquisition (i.e. with a purchase price above 5% of the sales of the acquisition previous year) was done over the period 2003-13. Nevertheless, because acquisitions can impact firms' growth in an organic and inorganic way, and because a set of several acquisitions were held over the period 2002-13, acquisitions is, indeed, a relevant growth driver for this case study.

4.6. Conclusion

Summing up, four main growth drivers are going to be analyzed. First, dividends and profitability since they can affect firms' financial resources to invest on the business and foster further growth. Second, international activity, due to the outstanding sales increase in the Asian market. Third, innovation, since it was suggested to play a significant role in the chemical industry. Finally, acquisitions, because of firms' numerous acquisition deals over the period 2002-13. In this context, Part 5 will now address each one of this growth drivers, in order to identify those which impacted firms' growth and distinguish benchmarks from the rest of the firms.

5. Analysis of the Selected Growth Drivers

5.1. Introduction

This part is dedicated to an analysis of the selected growth drivers. In this tense, this part is divided into four chapters, in order to analyze, separately, each selected growth driver: *i)* dividends and profitability, which are going to be analyzed jointly; *ii)* firms' international activity; *iii)* innovation; *iv)* acquisitions. Each one of these chapters is divided into four sections. First, an introduction explaining the hypothesis that are being tested. Note that such hypothesis are linked with the two sub-objectives of this thesis: i.e., to identify the growth drivers that impacted firms' growth and to identify the growth drivers that distinguish benchmarks from the rest of the firms. Second, the metric to measure the growth driver and the data collection process will be presented. Finally, the third and the fourth sections will analyze the established hypothesis. Since the ultimate goal is to understand why benchmarks outgrew the rest of the firms over the period 2002-13, the last section presents a reflection of the overall analysis stated in this part, and a plausible answer to the problematic of this thesis.

5.2. Dividends and Profitability

5.2.1. Introduction

This chapter is oriented to understand if growth differences between benchmarks and the rest of the firms are caused, partially, by dividends - measured by dividend payout ratio - and profitability. First of all, Section 5.2.2. addresses the selection of the metrics and the data collection process. After, the core of this analysis will be based on a two-step approach. First, Section 5.2.3. is devoted to understand if profitability and dividends had a significant impact on firms' growth over 2002-2013. In other words, if profitability and dividends can be considered growth drivers for this case study. Based on the reasoning described in Chapter 4.2., let's consider Hypothesis 1a and Hypothesis 1b.

Hypothesis 1a: Profitability is positively correlated with growth for the set of firms under analysis and over the period 2002-13.

Hypothesis 1b: Dividend payout ratio is negatively correlated with growth for the set of firms under analysis and over the period 2002-13.

The second step (Section 5.2.3.) is oriented to analyze if there is significant differences between benchmarks and the rest of the firms in terms of dividends and profitability. Therefore, let's consider Hypothesis 2a and Hypothesis 2b.

Hypothesis 2a: Profitability is distinguishes benchmarks from the rest of the firms, with benchmarks presenting higher profitability levels over the period 2002-13.

Hypothesis 2b: Dividend payout ratio is distinguishes benchmarks from the rest of the firms, with benchmarks presenting lower dividend payout ratios over the period 2002-13.

5.2.2. Metric Selection and Data Collection

This data collection has the ultimate goal of measuring firms' profitability and calculate the dividend payout ratio. Note that dividend payout ratio is the selected metric to analyze dividends as a growth driver. To access to such data, Bloomberg Terminal was used. However, to measure profitability, one should, first of all, select an appropriate metric. Based on the literature review, it was possible to understand that scholars use different metrics. Table 1 presents some of the most common metrics used by scholars.

Table 1 Common Profitability Metrics in the Literature **Source** The Author Based on (Coad, 2007b; Goddard et al., 2005; Lee, 2014)

Metric	Formula
Profit Margin	Net Income/Sales
Profit Rate	Operating Surplus/Value Added
ROA	Return/Assets
ROE	Return/Equity
ROS	Return/Sales

The selected metric was profit margin. In short, profit margin measures firm's net income per unit of sales. While the presented metrics can have different advantages and disadvantages, this selection takes into account the main objective of studying the relation growth-profit. The main goal is to try to understand to which extent benchmarks are able to increase their retained earnings, which can, eventually, given them the means to increase investments to foster additional growth. The reason why profit margin was selected is based on the fact that,

and remembering Chapter 4.2., this metric is the one that most affects in a direct way retained earnings (since it includes net income). Additionally, note that most of the metrics measure profitability relatively to firm's size. Since one is using sales to measure firm size, profit margin is perfectly suitable to this analysis.

In this context, for profitability, the data collection was done based on firms' financial and annual reports (note that net income is the bottom line of an income statement). In the end, it was possible to measure profitability and the dividend payout ratio over the period 2002-13.

5.2.3. Testing Dividends' and Profitability's Impact on Growth

As explained in Section 3.3.1., a panel data model will be used to test if profitability and dividend payout ratio are significantly correlated with growth, which can suggest their impact on growth. Note that there is no such work studying the profit- and dividends-growth relations (to the best knowledge of the author, dividends are not addressed in the literature). In this context, the regression model (Eq. 3) is based on (Lee, 2014), but variables were added to take into account the dividend payout ratio.

$$Growth_{i,t} = \beta_0 + \sum_{j=1}^{2} \beta_j \pi_{i,t-j} + \sum_{j=1}^{2} \beta_{j+2} d_{i,t-j} + \beta_5 control_{i,t-1} + \varepsilon_{i,t} \qquad \text{Eq. 3}$$

, where i refers to firms; t to year; β to regression coefficients; $control$ to control variables, namely firms' size[1] and year dummies (mainly because of macroeconomic fluctuations denoted during the financial crisis of 2008); $\varepsilon_{i,t}$ to the usual error term; $Growth$ is described by Eq. 4; π to profit margin, with a lag period of 1 and 2 years[2] (Eq. 5); d to dividend payout ratio, also with a lag period of 1 and 2 years (Eq. 6).

$$Growth_{i,t} = \frac{Sales_{i,t} - Sales_{i,t-1}}{Sales_{i,t-1}} * 100 \qquad \text{Eq. 4}$$

$$\pi_{i,t} = \frac{Net\ Income_{i,t}}{Sales_{i,t}} * 100 \qquad \text{Eq. 5}$$

$$d_{i,t} = \frac{Dividends_{i,t}}{Net\ Income_{i,t}} * 100 \qquad \text{Eq. 6}$$

[1] ln(size), as in (Lee, 2014).

[2] Lag periods are used to take into account delayed effects of profitability and DPO levels on growth.

For the sake of simplicity, descriptive statistics regarding the variables of interest are stated in Annex 4. Note that the linear model is applied to growth data over the period 2004-13. This is because available data was only found for the period between 2002 and 2013 and it was necessary to consider a lag of 1 and 2 years. This constitutes a limitation.

Concerning using fixed effects model or random effects model, the Hausman test suggested the application of the fixed effects model (please see Annex 4). In this context, Table 2 presents the regression results for fixed effects model.

Table 2 Regression Results for Fixed Effects Model (*DPO=Dividend Payout Ratio) **Source** Performed in R Software

	Estimate (β)	**Std. Error**	**t-value**	**Pr (>| t |)**
Profit Margin (t-1)	0.462065	0.339560	1.3608	0.12821
Profit Margin (t-2)	0.911034	0.366414	2.4863	0.01544*
DPO (t-1)	-0.028624	0.022999	-1.2446	0.21769
DPO (t-2)	0.053141	0.023974	2.2166	0.03010*

Notes: This table shows the regression results for Eq. 3; size of the firms and year dummies are used as control variables but not reported. R-Squared=0.34603. p-value=6.5192*10^(-5). *Significant at 5% level ** Significant at 1% level *** Significant at 0.1% level.

Based on Table 2, one can affirm the following remarks: *i)* profit margin is significantly and positively correlated with growth rate of the year, with a lag period of 2 years; *ii)* dividend payout ratio is significantly and positively correlated with growth rate of the year, also for a lag period of 2 years. For the rest of the two variables, no significant correlations were found.

Note that the result stated in *i)* is the expected one, and so one can suggest that Hypothesis 1a is supported. Based on such correlation, the author suggests that profitability has a positive impact on growth; so, more profitable firms are more likely to grow at higher rates. Additionally, one should analyze the value of the estimations of the regression coefficient to understand if the impact on growth is significant. According to the fixed effects model, +1% of profit margin will affect, in 2 years, sales growth in +0.9%. Obviously that such affirmation have several statistical limitations. E.g., the standard error assumes a value of 0.37%, which can be considered high and can affect significantly the conclusions based on the

regression coefficient estimation; or, correlation does not imply causality. Nevertheless, such value gives a perception of the extent to which profit margin affects sales growth. In fact, as stated in Figure 7, this impact on growth is significant. The average profit margin differences (over 2002-13) between benchmarks and rest of the firms go up to 6.2%, which, according to the regression coefficient, can be translated into yearly growth differences of up to 6.2*0.9=5.6%, which is significant[1].

Concerning the second remark stated in *ii)*, regression results showed a positive correlation between dividend payout ratio and growth, which goes against expectations. Thus, at a first glance, one can suggest that Hypothesis 1b is rejected. A positive correlation between dividend payout ratio and growth can imply the higher engagement of investors on the firm due to a more rewarding dividend policy. Moreover, the estimation of the regression coefficient assumes a value of nearly 0.05, suggesting that +1% in terms dividend payout ratio can impact, in 2 years, sales growth in +0.05%. However, the author suggests that the relation between growth and dividend payout ratio is not clear. This is mainly because of two reasons. First, note that the relation between dividend payout ratio with a lag period of 1 year, despite not significant, presents a negative correlation with growth (so, against the positive correlation between growth and dividend payout ratio with a lag period of 2 years). Second, the standard deviation of coefficient estimation for dividend payout ratio with a lag period of 2 years is significantly high (0.024, representing almost 50% of the coefficient estimation).

As a conclusion, one can affirm can the statistical model supports the veracity of Hypothesis 1a, but rejects Hypothesis 1b. This suggests that profitability fostered firms' growth over the period 2002-13. Moreover, dividend payout ratio does not seem to be related with growth. However, several limitations can be pointed to these conclusions. The most significant limitation is that the effect of profitability and dividends on growth was studied only over the period 2004-13, due to data availability issues, while the goal is to understand growth over the period 2002-13. Another limitation concerns the relation between the dividend payout ratio and growth. Due to such ambiguous results, the author suggests a non-linear relationship between these two variables. More concretely, with an inverted U-shape. In first place, low values of dividend payout ratio can affect negatively investors' interest on firm. In second place, it is expected that a higher dividend payout ratio can attract new investors and motivate current investors to invest on the firm, supporting growth. However, in

[1] Note that, mathematically, several limitations can be pointed to this reasoning. Nevertheless, the values give the perception of the significant impact of profit margin on growth.

third place, a high dividend payout ratio can also diminish in a significant way retained earnings, affecting in a negative way firm's investments to foster growth. Therefore, the author suggests further research in this issue. In this reasoning, growth can partially depend on the trade-off between establishing a high dividend payout ratio to foster investors' interest on firm, and a low dividend payout ratio as a means to increase investment.

5.2.4. Testing Dividends and Profitability as Distinguishing Growth Drivers

Based on the previous results, the following affirmations can be done: *i)* dividend payout ratio does not seem to have a clear impact on firms' growth; *ii)* profitability is suggested to foster growth. Now, the goal is to perform a comparative analysis between benchmarks and rest of the firms. Note, however, than even if there is a clear distinction, in terms of dividend payout ratio, between benchmarks and the rest of the firms, one cannot assume that growth' differences between them are caused, partially, by dividends (assuming that correlation is indeed expressing the impact on growth).

Let's first analyze the dividend payout ratio. Figure 7 presents the average dividend payout ratio over the period 2002-13 (calculated through the yearly values). As one can see, there is not a clear difference between benchmarks and the rest of the firms. Most of the firms allocated similar proportion of profits to pay dividends, close to 61% (above European and American averages). The main differences concern Floridienne and The Dow Chemical Company, which present significantly higher and lower dividend payout ratios, respectively. Nevertheless, there is not a clear pattern distinguishing benchmarks from the rest of the firms. Therefore, the author suggests the rejection of Hypothesis 2b.

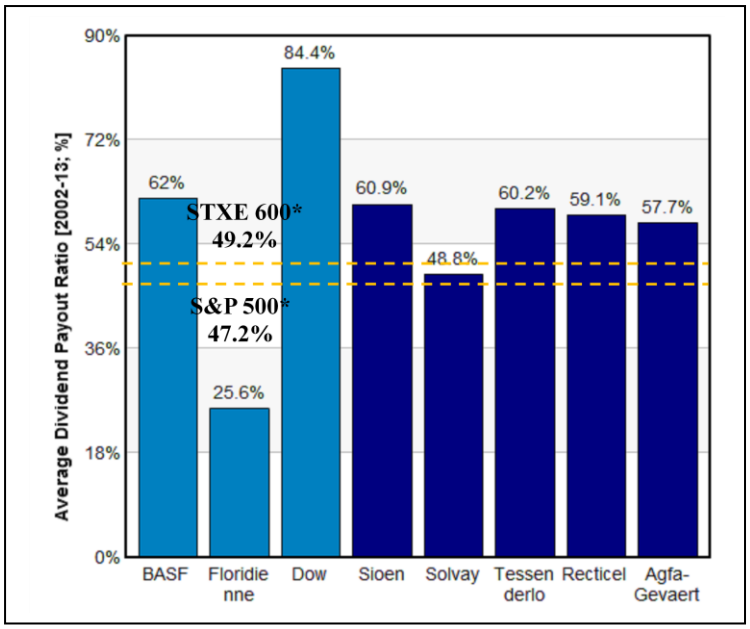

Figure 7 Average DPO [2002-13; %] per Firm (*STXE 600 refers to Average DPO of Chemical Firms listed in STOXX Europe 600 Index; same for S&P 500) **Source** Bloomberg Terminal

Let's now investigate profit margins. Analyzing the average profit margin over the period 2002-13 allows to understand, in a general way, to which extent each firm was able to be profitable along the period under analysis. As one can see in Figure 8, at a first glance, there is not a clear difference between benchmarks and the rest of the firms.

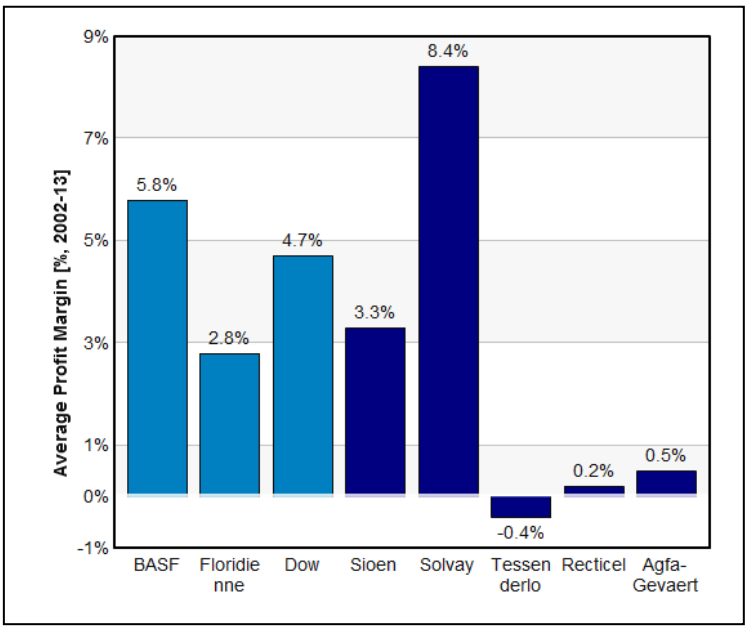

Figure 8 Average Profit Margin [2002-13; %] per Firm **Source** The Author based on BASF's, Floridienne's, The Dow Chemical Company's, Solvay's, Sioen's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports

The main highlight is that Tessenderlo, Recticel and Agfa-Gevaert, which are the firms that presented negative growth over the period 2002-13, present also residual profit margins. For example, if one compare Tessenderlo and BASF, there is a difference of 6.2% in terms of average profit margin over the period 2002-13. Remembering the last section, this can mean a difference, in terms of yearly growth rate, of 0.9*6.2=5.6%, which is extremely significant (remember Figure 4). Thus, one can suggest that Tessenderlo, Recticel and Agfa-Gevaert have been struggling to grow in part due to their low profitability levels.

However, there are two exceptions. First, Floridienne is a benchmark and presents a lower profit margin average *vis a vis* Sioen and Solvay. This issue was discussed, along with an expert, in a meeting that took place on 30th April 2015 (Annex 3). A likely reason for this regards the bankruptcy of a Floridienne's subsidiary in 2011 that affected significantly the profit margins in 2012 and 2013. Taking into account this matter, the average profit margin of Floridienne was calculated over the period 2002-11: the result was of 4.8%. Note that this value goes in line with expectations. It is indeed higher than the average profit margin of the rest of the firms (excluding Solvay). Moreover, the statistical model showed that the profit margin has an effect on growth only after 2 years. Thus, low values in terms of profit margin in 2012 and 2013 are only expected to have effects in 2014 and 2015. Given this context, and taking into account that such subsidiary bankruptcy is an once-off event, it is possible to say that Floridienne has been able to achieve higher profitability margins than the rest of the firms

- excepting Solvay. So, excepting Solvay, profitability seems to be distinguishing benchmarks from the rest of the firms.

Concerning Solvay, the author tried to analyze the reason behind such high levels of profit margin with relatively lower growth rates, and an important issue was found: Solvay sold a valuable pharmaceutical subsidiary in 2010. According to Solvay's annual report, such divestiture represented EUR 1.7 Billion in capital gains. In fact, Solvay's profit margin in 2010 has an exceptional value of 30.6%, and the capital gains represent roughly 94% of it. Since this is not a representative event, the average profit margin was calculated excluding the capital gains of this divestiture. However, even in this way, Solvay presents a profit margin of 6%, which is a significant value comparing to benchmarks.

To conclude, the author believes that there is a significant difference between benchmarks and the rest of the firms in terms of profitability. Firms with negative growths over the period 2002-13 present residual profit margins. Sioen also presents lower values when comparing to benchmarks (if one consider 4.8% for Floridienne). Since there is one exception, which is Solvay, the author suggests that Hypothesis 2a is partially supported.

5.3. Firms' International Activity

5.3.1. Introduction

This chapter is devoted to understand if growth differences between benchmarks and the rest of firms are caused, partially, by firms' sales growth in a specific geographical area: Asia. For this growth driver, a different methodology will be employed. Instead of using a panel data to understand the impact of Asia on firms' growth, the author opted to follow a simpler and more effective approach. Since there is data concerning firms' sales per geographical area, a simple mathematical-based approach will be used to understand what was the impact of each geographical area to firms' growth over the period 2002-13. In this context, first, Section 5.3.2. presents the data collection process. After, Section 5.3.3. is dedicated to understand if Asia is the geographical area that had the highest impact on firms' sales growth. As discussed in Chapter 4.2., the motivation to study firms' internationalization is based on current market trends: with Asia showing a significant boom in terms of sales in the chemical industry. As showed, this is a trend affecting the last years, so including the period over 2002-2013. Given this, let's consider Hypothesis 3a, which will be tested in Section 5.3.3..

Hypothesis 3a: Asian market is the geographical area with the highest impact on growth of the set of firms under analysis and over the period 2002-13.

Regardless Asia's impact on firms growth, the second objective of this analysis is oriented to understand if sales growth in Asia distinguishes benchmarks from the rest of the firms. In this sense, one is expecting that benchmarks were able to grow at significantly higher rates when comparing to rest of the firms. Therefore, Section 5.3.4. will test the following hypothesis.

Hypothesis 3b: Against the rest of the firms, benchmarks grew significantly in Asia over the period 2002-13.

5.3.2. Data Collection

Understanding the effect of internationalization on each firm's growth requires a careful data collection and analysis. Three main problems were identified during data collection: *i)* data bases have usually data about exportations; however, often, a significant number of values are undisclosed; *ii)* data bases usually do not present exportations per geographical area; *iii)* regardless the previous problems, exportations are not the unique metric to measure firm's internationalization (e.g. a firm can have a foreign subsidiary, which is not taken into account by exportations values but it is, indeed, an international activity).

In this context, the data collection was done through an intensive research based on firms' annual and financial reports. This allowed to collect data concerning firms' sales per geographical area over the period 2002-13. Note that sales per geographical area are disclosed taking into account the sales of the firm and its subsidiaries per customer location. One obstacle to this analysis is that data is not completely comparable between firms, since data about sales per geographical area is usually disclosed in different ways (e.g. while some firms present specific data about sales in Asia, others present aggregated sales in Asia and Africa). Here, two extreme data treatment approaches can be performed: *i)* try to aggregate all the data according to the geographical areas of the less detailed annual report, in order to have comparable data; *ii)* maintain each firm's original formulation of disclosed data, and perform a data analysis taking into account such differences between firms. The second option was selected, since it allows to have more detailed data. The author considered that data aggregation would imply a significant loss of data, going against the objectives of this analysis.

Concluding, the data pool consists on firms' sales per geographical area depending on customer location and between 2002 and 2013. Floridienne has not publicly available data regarding this matter, but has kindly provided it for this thesis (however, only data over the period 2006-13 is available). Moreover, for Sioen Industries was only possible to collect data for the period between 2005 and 2013. These firms are going to be included in this analysis, but it is important to state such limitation.

5.3.3. Testing International Activity's Impact on Growth

This section is devoted to test Hypothesis 3a. For this purpose, one should analyze what is the geographical area that had most of the impact on firms sales growth over the period 2002-13. Each firm will be analyzed individually, since there is no comparable data between firms. Geographical areas' impact were analyzed taking into account their contributions to firms' sales growth from 2002 to 2013. This can be a biased approach if firms' sales per geographical area varied significantly and in different directions year over year. So, to ensure that there is actually a constant trend over 2002-13, the author collected data regarding sales per geographical area for each year of the period under analysis. Annex 5 presents such data, more concretely sales (%) per geographical area, in which it is possible to conclude that the evolution from 2002 to 2013 in terms of sales per geographical area is quite linear in most of the cases. Hence, it is possible to do a plausible analysis just using just data relatively to 2002 and 2013. Figure 9 is relative to BASF.

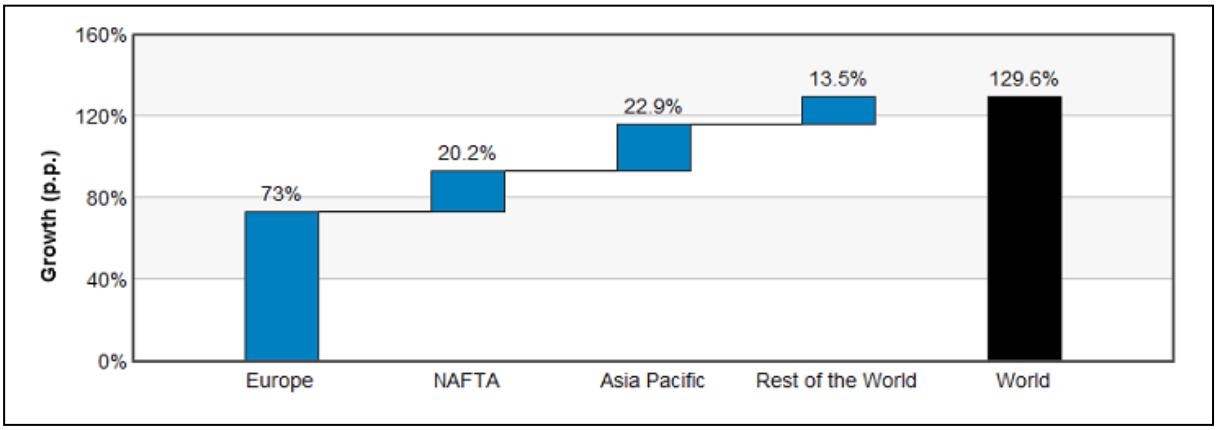

Figure 9 BASF Sales Growth per Geographical Area over the Period 2002-2013 (*NAFTA= North America Free Trade Agreement, including USA, Canada and Mexico; p.p.=percentage points) **Source** BASF's Financial and Annual Reports

As showed in Chapter 3.2., BASF increased its sales in 129.6 percentage points (p.p.) over the period 2002-2013. The first remark that can be done concerning Figure 9, is that BASF grew in all the four disclosed geographical areas: Europe, NAFTA, Asia Pacific and Rest of the World. Additionally, when analyzing what is the geographical area that driven most part of the growth, even visually is clear that European market presents the highest growth (73 p.p.), which represents more than half of BASF's total growth (73/129.6=56.4%). This is followed by the Asia Pacific market, contributing with 17.7% (i.e. 22.9/129.6) to the total growth, less than a half of the European market's contribution. Note that, in relative terms, it is likely that sales in Asia Pacific grew more than sales in Europe. However, contribution to overall growth depends on the absolute value of growth. So, what is important to notice is that, in fact, more than half of BASF's growth was supported by sales in Europe, reason why can be considered the market that driven most of BASF's growth over the period 2002-2013. Thus, for this case, Hypothesis 3a is rejected. Figure 10 is relative to Floridienne's sales.

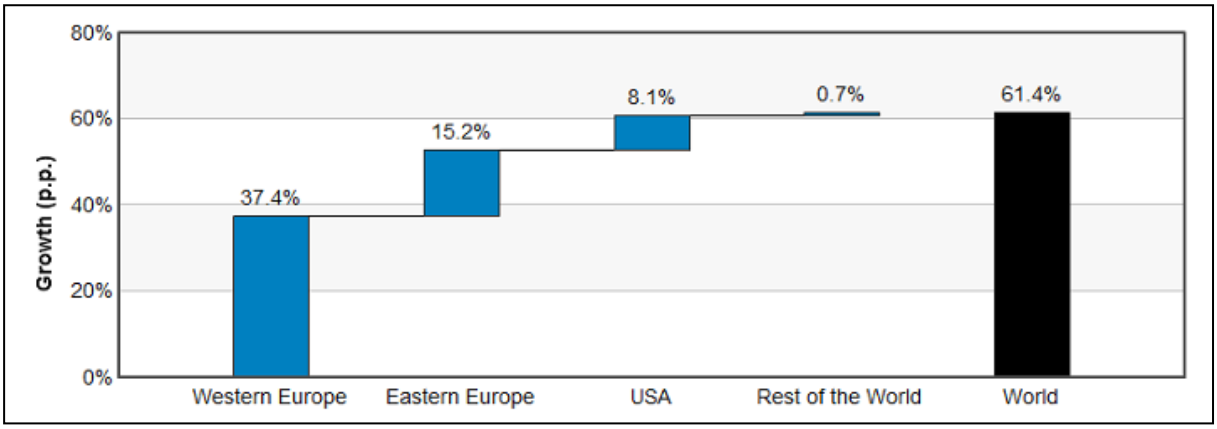

Figure 10 Floridienne Sales Growth per Geographical Area over the Period 2006-2013 (*p.p.=percentage points) **Source** Floridienne's Financial and Annual Reports

Floridienne grew 61.4 p.p. over the period 2006-2013, presenting a positive growth in all disclosed geographical areas: Europe (separated into Western and Eastern Europe), USA and Rest of the World. It is clear that Europe (mostly Western part) is the geographical area driving most of Floridienne's growth. In fact, in terms of contribution, nearly 86% (37.4% plus 15.2% divided by 61.4%) of Floridienne's growth over the period 2006-2013 was driven by sales in Europe. Once again, and even more when comparing to BASF, Europe is the geographical area with the highest impact on growth. Despite the data limitation (since it was only possible to find data between 2006 and 2013), the author suggests the rejection of Hypothesis 3a for this case. Figure 11 is referred to The Dow Chemical Company.

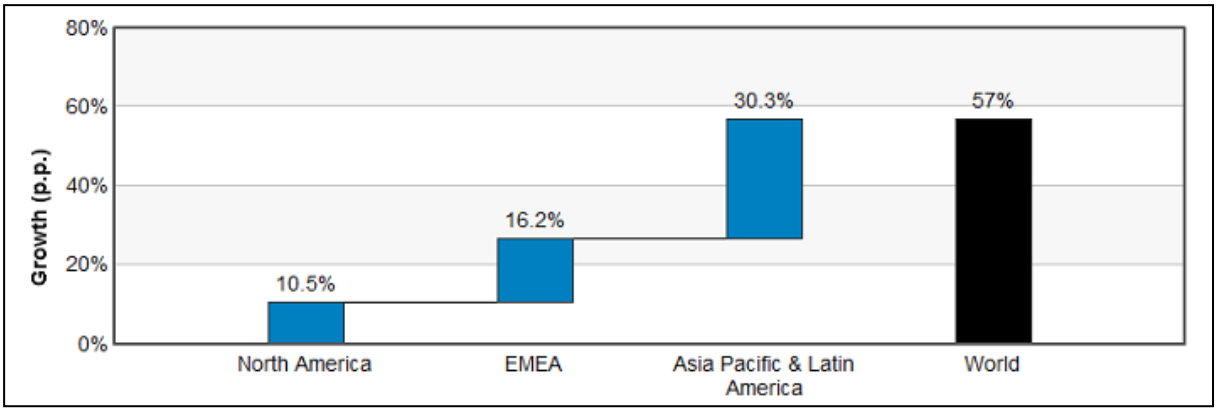

Figure 11 The Dow Chemical Company Sales Growth per Geographical Area over the Period 2002-2013 (*EMEA= Europe, Middle East and Africa; *p.p.=percentage points) **Source** The Dow Chemical Company's Financial and Annual Reports

The Dow Chemical Company's sales grew 57 p.p. over 2002-2013. The category that most contributed to overall growth is Asia Pacific & Latin America, with a growth of 30.3 p.p. and contributing to more than a half (58%) of total growth. Concerning EMEA, the second category that most contributed to overall growth, the author believes that is mainly due to Europe. This is because of the high sales growth rate in Europe over 2003-08 (period in which The Dow Chemical Company present sales in Europe separated from sales in Middle East and Africa). In this period, sales in Europe present a CAGR of roughly 11.7%, which is significantly high. Nevertheless, for The Dow Chemical Company, Hypothesis 3a cannot be tested since no data was found to distinguish growth between Asia Pacific and Latin America. Figure 12 refers to Sioen Industries.

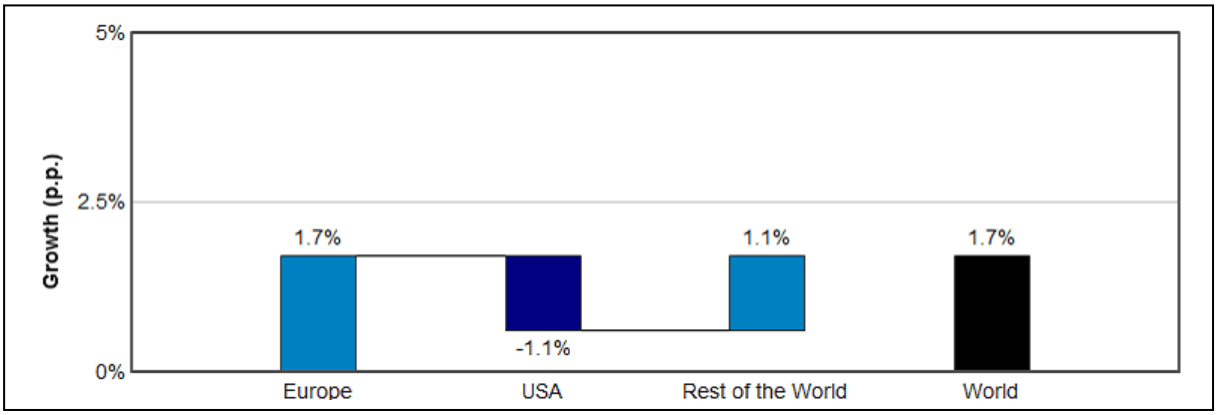

Figure 12 Sioen Sales Growth per Geographical Area over the Period 2005-2013 (*p.p.=percentage points; **Europe includes Benelux, France, Germany, UK, Spain, Switzerland, Eastern Europe, Austria, Ireland, Italy) **Source** Sioen's Financial and Annual Reports

As already stated, only data over the period 2005-13 was found for Sioen. In this period, Sioen just grew 1.7 p.p., since most of Sioen's growth over the period 2002-2013 took place between 2002 and 2005. So, it is difficult to do a proper analysis regarding what is the geographical areas that driven Sioen's growth. Nevertheless, in terms of positive growth, Europe is the main growth driver, growing 1.7 p.p., so contributing in 100% for total growth (this is because there are categories with negative growth). In terms of negative growth, USA is the unique geographical category presenting decreases. Despite this, and since Sioen grew, one can state that, over the period 2005-2013, most of the growth was driven by Europe, while declines were leaded by USA. Concerning Asian market, Sioen does not disclose such data between 2005 and 2013. However, judging by the data label as "Rest of the World", Hypothesis 3a does not seem to be supported. Figure 13 refers to Solvay's sales growth.

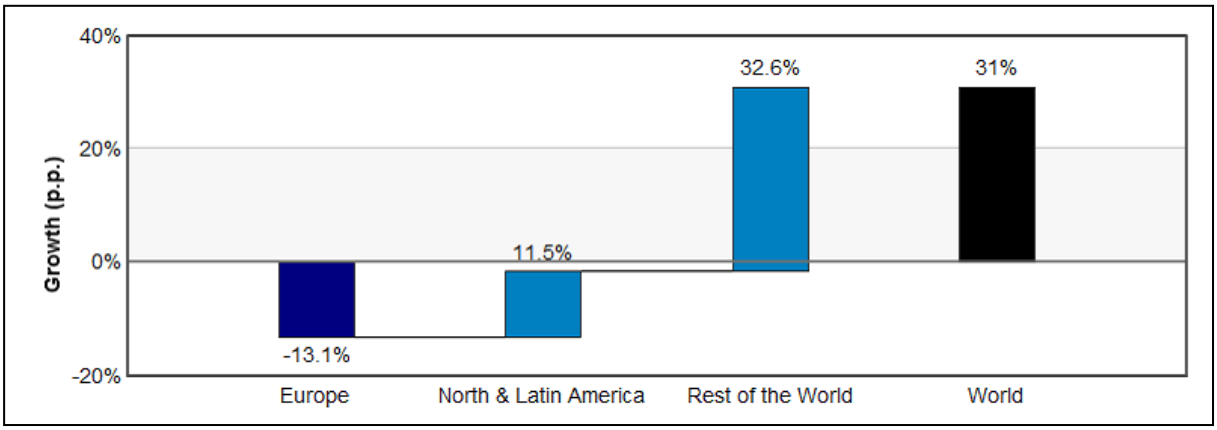

Figure 13 Solvay Sales Growth per Geographical Area over the Period 2002-2013 (*p.p.=percentage points)

Source Solvay's Financial and Annual Reports

Over 2002-13, Solvay grew 31 p.p.. In Solvay's annual reports, Asia Pacific is indeed a geographical area included in the label "Rest of the World". However, due to data aggregation, it is impossible to state any judgment concerning Hypothesis 3a. Additionally, the second category with highest impact on overall growth is Europe (with a negative impact), being the only category presenting a decrease in terms of sales. In fact, sales decline in Europe count for -42% of total growth (-13.1/ 31), which is significant. So, despite the impossibility to identify the market driving positive growth, Europe is the market driving negative growth, and with a significant weight in overall growth. Figure 14 refers to Tessenderlo sales growth.

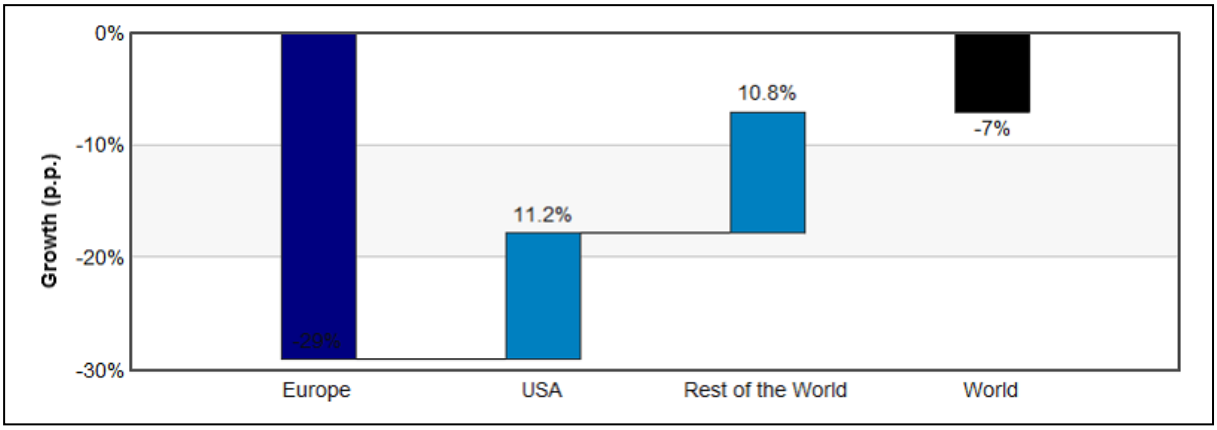

Figure 14 Tessenderlo Sales Growth per Geographical Area over the Period 2002-2013 (*p.p.=percentage points) **Source** Tessenderlo's Financial and Annual Reports

Tessenderlo suffered sales decline of 7 p.p. over the period 2002-2013. As it is possible to observe, the geographical area with the highest impact on growth is Europe (negative impact), weighting 414.3% relatively to overall sales decline. Concerning positive growth, the geographical area with the highest impact in growth is USA. In this context, Asia does not seem to be the geographical area with the highest impact on growth. Hypothesis 3a is suggested to be rejected for this case. Figure 15 refers to Recticel's sales.

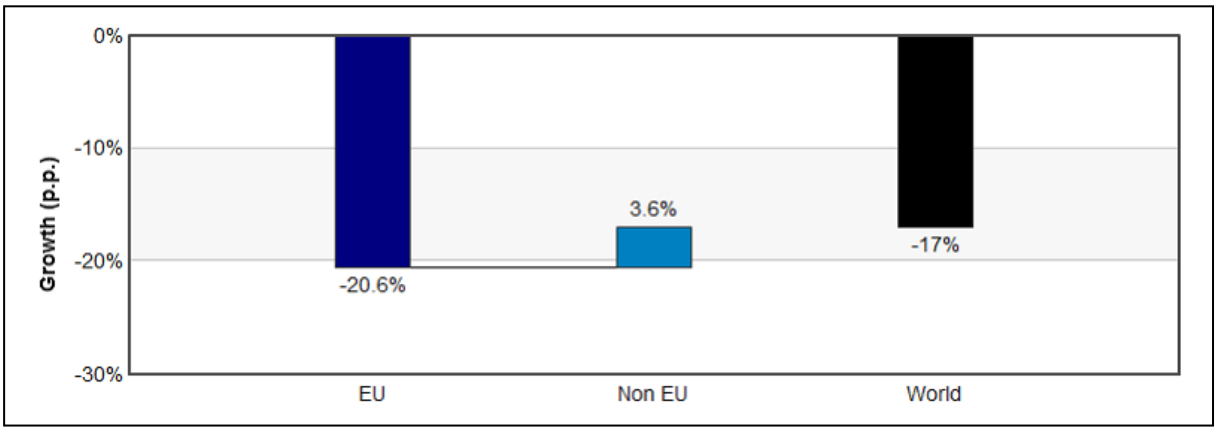

Figure 15 Recticel Sales Growth per Geographical Area over the Period 2002-2013 (*EU= European Union; p.p.=percentage points) **Source** Recticel's Financial and Annual Reports

Recticel suffered sales decline of 17 p.p.. The division here is between EU countries and Non EU countries. The geographical area with highest impact on growth is clearly EU, with a weight of 121.2% relatively to overall sales decline. On the other side, sales in Non EU countries had a relatively small impact on sales, with a residual growth with a weight of -21.2% over total sales decline. In this context, Hypothesis 3a is suggested to be rejected. Finally, Figure 16 refers to Agfa-Gevaert.

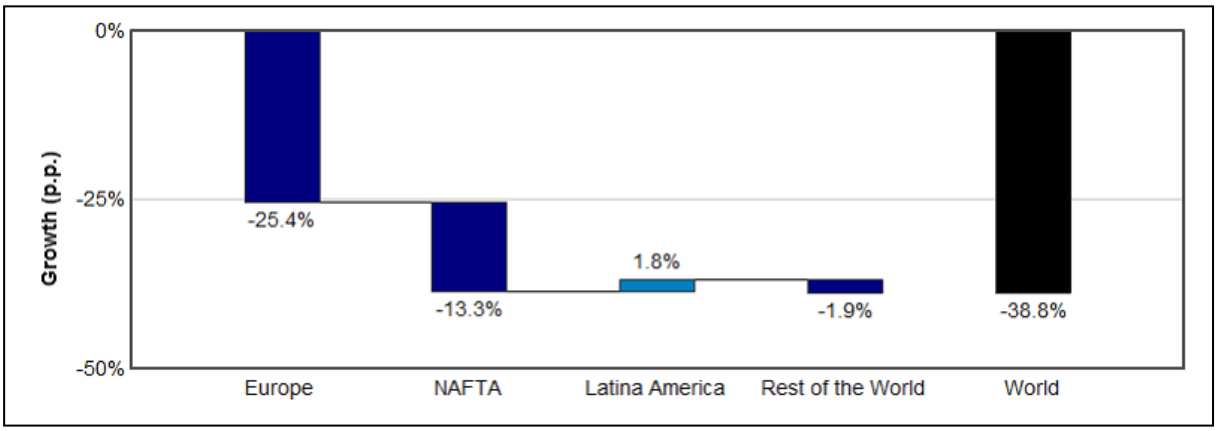

Figure 16 Agfa-Gevaert Sales Growth per Geographical Area over the Period 2002-2013 (*EU= European Union; *p.p.=percentage points) **Source** Agfa-Gevaert's Financial and Annual Reports

Agfa-Gevaert decreased its sales by 38.8 p.p.. Europe is again driving sales decline, contributing with 65.5% for overall sales decline. Concerning positive growth, only Latin America showed an increase in sales: with a residual impact in overall growth (nearly -0.5%). Henceforth, and since the label "Rest of the World" presents a low impact on growth, Hypothesis 3a is suggested to be rejected for this case.

Since all the firms were analyzed, one can reflect about the veracity of Hypothesis 3a. Despite all data limitations, the author suggests that such hypothesis is not verified. Concerning BASF, Asia Pacific shows actually an important impact on growth: however, Europe had a significantly higher impact. Regarding Floridienne, Europe is once again the geographical area with the highest impact on growth (more than 80%). For Sioen, Recticel, Agfa-Gevaert and Tessenderlo, Europe is also suggested to be the geographical area with the highest impact on growth (negative or positive impact). This is because the category "Rest of the World" presents a lower impact. Obviously that there is the possibility to have Asia presenting high impact on growth, with other countries within "Rest of the World" canceling such impact. However, this is not a likely scenario. In fact, usually the most important geographical areas are disclosed separately in annual reports (which is not the case). The unique exceptions to this trend (i.e. Europe impacting most part of growth) are The Dow Chemical Company and Solvay. For the Dow Chemical Company, it is not possible to distinguish the impact of Asia Pacific from Latin America, while for Solvay there is only data concerning Rest of the World. Nevertheless, in general, the author suggests that Hypothesis 3a is not supported.

Despite the rejection of Hypothesis 3a, the data suggests a significant finding: among European firms, the European market explain, over 2002-13, a significant part of firms' growth. For BASF and Floridienne, more than 50% and 80% of growth, respectively, was driven by sales in Europe. For Solvay, sales in Europe declined, representing more roughly -40% of overall growth. Data also suggests that, concerning Tessenderlo, Recticel and Agfa-Gevaert, sales decrease were mainly caused by sales decline in Europe. Unfortunately, for Sioen Industries, it is difficult to understand the impact of Europe in its growth, because of the already stated reasons. Nevertheless, due to the previous analysis, Europe (instead of Asia) is suggested to be the geographical area that counts for most of the impact on European firms' growth (negative or positive), over the period 2002-13.

5.3.4. Testing International Activity as Distinguishing Growth Driver

As it was possible to understand in the last section, Asia is not likely to be the geographical area having most of the impact on firms' growth. While it was possible to, with some limitations, test Hypothesis 3a (since the goal was to try to understand the geographical area with the highest impact on firms' growth, which was suggested to be Europe), if there is no data concerning sales in Asia, there is no possibility to test Hypothesis 3b. Because of this, one appealing solution is to reformulate such hypothesis. Since Europe was suggested to be the main growth driver among European firms, and since one wants to understand why benchmarks outgrew the rest of the firms, Hypothesis 3b* is going to considered.

Hypothesis 3b*: Against the rest of the firms, benchmarks grew significantly in Europe over the period 2002-13.

Based on the last section, this hypothesis is expected to be verified. For an easier analysis, Figure 17 presents sales in Europe and over the period 2002-13 (CAGR)[1].

[1] Note that The Dow Chemical Company is going to be excluded due to data aggregation issues.

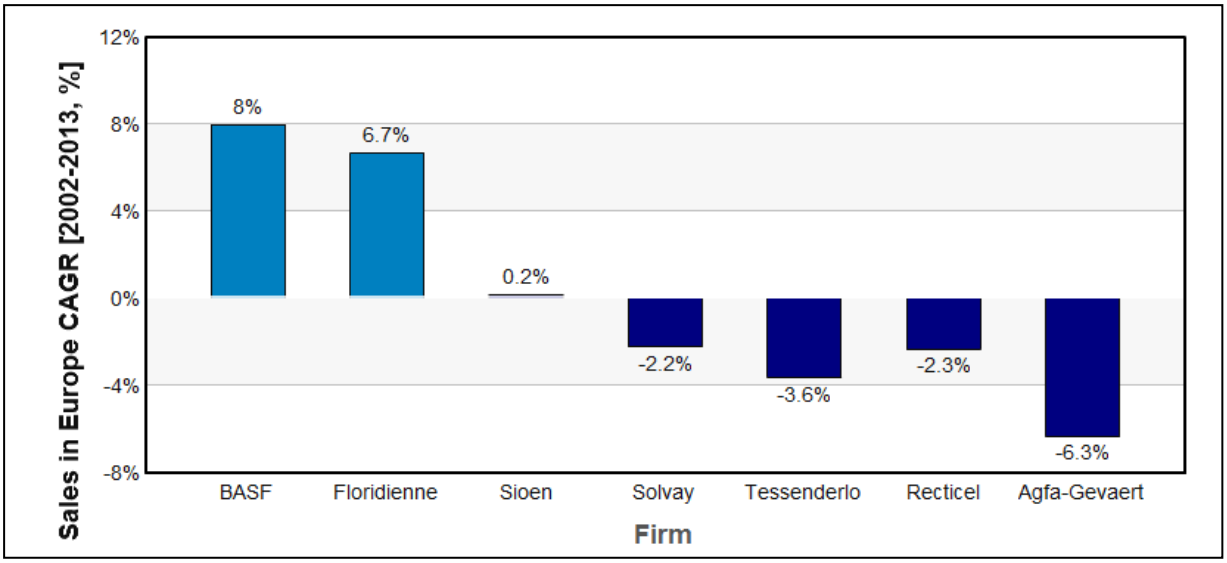

Figure 17 Sales in Europe CAGR [2002-2013; %] (*Sioen refers to Europe Union; **Sioen only over 2005-13; *** Floridienne only over 2006-13) **Source** BASF's, Floridienne's, Sioen's, Solvay's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports

Despite all data limitations, it is interesting that the performance in Europe distinguishes in a clear way benchmarks from the rest of the firms. Note that benchmarks grew considerably in Europe, with sales CAGR significantly higher than Europe sales CAGR over the period 2002-13 (2.2%). On the reverse side, rest of the firms present lower growth rates than 2.2%. In fact, all of them present negative growth rates in Europe, excepting the best performer among rest of the firms: Sioen, which presents a residual growth rate. Supported on this, the author suggests that Hypothesis 3b* is verified: benchmarks were able to grow in Europe, while the rest of the firms did not.

5.4. Innovation

5.4.1. Introduction

This chapter is devoted to understand if growth differences between selected firms are caused, partially, by firms' innovativeness. Section 5.4.2. presents how innovativeness is going to be measured as well as the data collecting process. After, Section 5.4.3. is oriented to analyze innovativeness' impact on firms' growth. In this sense, innovation is expected to play a significant role on firms' growth in the chemical industry; thus, let's consider Hypothesis 4a.

> **Hypothesis 4a:** Innovativeness is positively correlated with growth for the set of firms under analysis and over the period 2002-13.

Second, Section 5.4.4. is dedicated to understand if benchmarks are more innovative when comparing to the rest of the firms, to understand if innovativeness is causing growth differences between those two groups. In this context, let's consider Hypothesis 4b.

> **Hypothesis 4b:** Innovativeness distinguishes benchmarks from the rest of the firms, with benchmarks being more innovative over the period 2002-13.

5.4.2. Metric Selection and Data Collection

Concerning metrics oriented to quantify innovativeness, several are presented during the literature. The most used ones are mainly R&D expenses, R&D intensity (i.e. ratio between sales and R&D expenses) and number of patents generated in a specific period of time - see e.g. (Del Monte & Papagni, 2003). Some other metrics are also used by scholars, such as multiple indicators and qualitative indicators. For this thesis, R&D intensity was selected due to two reasons. First, because R&D was identified as one critical aspect by the expert (see Annex 1). Second, because, against R&D expenses, R&D intensity gives the perception of to which extent a firm invests on innovation relatively to its size (important when the case study encloses firms with significant different sizes).

This metric requires the knowledge of firms' yearly R&D expenses and sales. For this, annual and financial reports of the selected firms were analyzed (usually, all the information was available in the income statements). Due to the lack of available data, the data set encloses R&D intensity values over the period 2004-2013 for all the firms under analysis excluding Floridienne.

5.4.3. Testing Innovation's Impact on Growth

This section is dedicated to test Hypothesis 4a. For the regression equation, the author opted to follow a simplification of the equation used in (García-Manjón & Romero-Merino, 2012)[1]. The regression equation is described below (Eq. 7).

[1] Nevertheless, a variable was added to take into account the impact of R&D Intensity on the same year of such expenses, as in, e.g., (Cucculelli & Ermini, 2012; Del Monte & Papagni, 2003).

$$Growth_{i,t} = \beta_0 + \sum_{j=0}^{j=1} \beta_{j+1} RDint_{i,t-j} + \beta_3 Control_{i,t-1} + \varepsilon_{i,t} \quad \text{Eq. 7}$$

, where i refers to firms; t to year; β to regression coefficients; $RDint$ refers to R&D intensity with no lag and a lag of 1 year; $control$ to control variables, namely firms' size, year dummies (mainly because of macroeconomic fluctuations denoted during the financial crisis of 2008); $\varepsilon_{i,t}$ to the usual error term; $Growth_{i,t}$ is described by Eq. 8.

$$Growth_{i,t} = \ln(Sales_{i,t}) - \ln(Sales_{i,t-1}) \quad \text{Eq. 8}$$

For the sake of simplicity, descriptive statistics regarding the variables of interest are stated in Annex 6. Note also that the linear model is applied to growth data over the period 2005-13. This is because available data was only found for the period between 2004 and 2013, it was necessary to consider a lag of 1 year for R&D intensity impact on growth. This constitutes a limitation. Additionally, Hausman test suggested the application of the random effects model (see Annex 6). In this context, Table 3 presents the regression results.

Table 3 Regression Results for Random Effects Model **Source** Performed in R Software

	Estimate	**Std. Error**	**t-value**	**Pr (>| t |)**
R&D Intensity (t)	1.8773890	3.7773544	0.4970	0.6210597
R&D Intensity (t-1)	-3.8125464	3.7422328	-1.0188	0.3125340

Notes: This table shows the regression results for Eq. 8; size of the firms and year dummies are used as control variables but not reported. R-Squared=0.23758. p-value=0.0030251. *Significant at 5% level ** Significant at 1% level *** Significant at 0.1% level

Based on Table 3, note that no significant correlation was found between R&D Intensity and growth. Actually, p-values of each regression coefficients are far from being close to the minimum acceptable (i.e. 5%). Moreover, standard deviations of each estimated linear coefficient are significantly high. Based on this, Hypothesis 4a is not supported by the statistical test. Note that some scholars had the same result. As stated in the literature, some authors struggled to find a positive correlation between firms' innovativeness, even in highly

scientific-based industries, such as the pharmaceutical industry - see e.g. (Bottazzi et al. 2001).

Taking into account the lack of correlation, the author suggests that firms' growth over the period 2002-13 was not significantly dependent on R&D Intensity. However, on the other side, the author also recognizes that such result can be due to limitations concerning the statistical model. In fact, there are several reasons that justify a non significant correlation between R&D intensity and growth, even when R&D intensity is essential to foster firms' growth. For example, the delay between R&D intensity and sales growth can be different across the set of firms, which can affect significantly results. Another possibility is the existence of a number of firms that were not able to capitalize on R&D intensity, due to, e.g., a poor sales and marketing department. Many other examples could be given. In these cases, R&D intensity can be indeed be important to grow, but statistical models may not be able to capture such impacts. Nevertheless, Hypothesis 4a is not supported.

5.4.4. Testing Innovation as Distinguishing Growth Driver

This section is oriented to test if benchmarks engaged more heavily on R&D than the rest of the firms. However, note that the panel data does not support the fact that R&D intensity had a significant impact on growth over the period. So, even if one proves that benchmarks engaged more on R&D than the rest of the firms (i.e. even if R&D is a distinguishing factor), R&D intensity cannot be suggested to be one of the growth drivers explaining benchmarks' higher growth *vis a vis* rest of the firms' growth. So, one option is to do not perform the rest of the analysis concerning R&D intensity. However, recognizing statistical limitations, the author decided that it is important to understand if R&D intensity distinguishes the two groups of firms.

Thus, the next step should be to perform a comparative analysis between firms and concerning R&D intensity. The selected approach is based on the comparison of the average values of yearly R&D Intensity over the period 2004-13. Additionally, R&D Intensity of each firm will also be compared with R&D intensity of the chemical industry in Europe and America, in order to understand if, for example, benchmarks/rest of the firms are above/below the average. For this, please see Figure 18.

Looking at the benchmarks, it is clear that all of them present higher levels of R&D intensity when comparing to the European and American average in the Chemical Industry. BASF presents an average of R&D Intensity of 2.5% *vs* the European Chemical Industry with 1.6%. The Dow Chemical Company presents a slightly higher number (2.7%), which is also clearly above the average in USA (1.9%). This is also true for three of the rest of the firms: namely, Sioen, Solvay and even Agfa-Gevaert, the one presenting the highest sales decline over the period 2002-13.

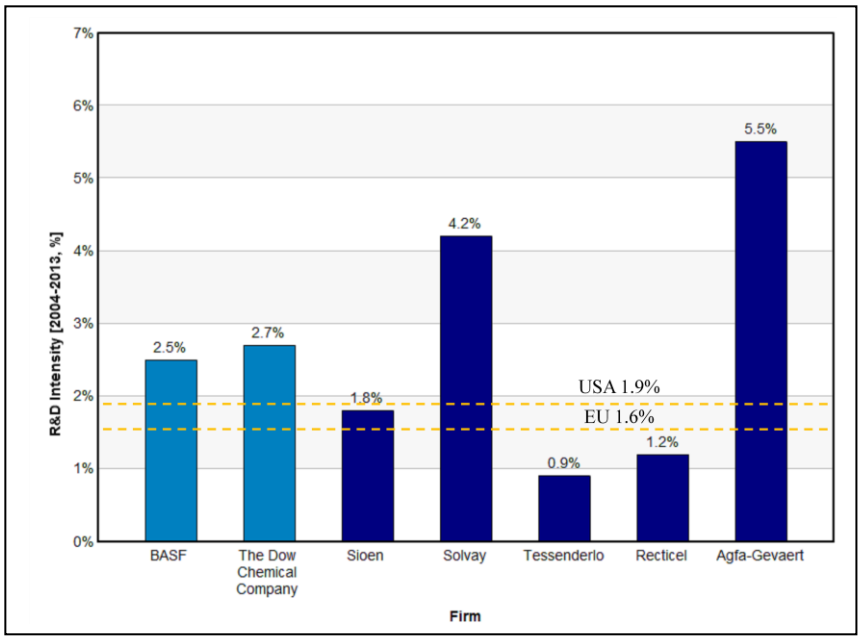

Figure 18 Average R&D Intensity (% of Sales) over the Period 2004-13, for the Selected Firms and Chemical Industry in United States of America (USA) and Europe (EU) **Source** The Author based on BASF's, Floridienne's, The Dow Chemical Company's, Solvay's, Sioen's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports, CEFIC

To support Hypothesis 4b, one should see a significant difference between BASF and The Dow Chemical Company and the rest of the firms. At a first glance, benchmarks only present higher values, in terms of R&D intensity, when comparing to Sioen, Tessenderlo and Recticel. Against Hypothesis 4b, Solvay and Agfa-Gevaert present higher values than the benchmarks. So, at a first glance, one should reject Hypothesis 4b.

However, during the meeting that took place on 30th April 2015 (Annex 3), two powerful insights were acknowledged. First, Solvay had, over the period 2002-10, a strong activity in the pharmaceutical industry (as stated in Chapter 5.2.). After, in 2010, Solvay sold an important subsidiary on the pharmaceutical industry. The point here is that R&D intensity levels are much higher in the pharmaceutical industry when comparing to the chemical industry. Thus, the value of 4.2% can be biased. One way to better understand the engagement of Solvay on R&D is to analyze R&D intensity after 2010. In fact, according to Solvay's annual report, the average of R&D intensity between 2010 and 2013 is 2.2%. So, slightly lower than benchmarks.

The second insightful concerns Agfa-Gevaert. One plausible reason to justify Agfa-Gevaert's high R&D intensity and sales decline is the industry in which this firm had activity. In short, until 2004, Agfa-Gevaert's business was mainly related with consumer-oriented photographic products. In this context, Agfa-Gevaert was highly penalized with the decline of this market due to the establishment of the digital photography industry. This suggests that Agfa-Gevaert has been trying to change its strategic focus, making an outstanding effort in terms of R&D intensity to catch up competitors.

In conclusion, the author suggests that Hypothesis 4b is partially supported. While a quantitative analysis provided a first approach to examine R&D intensity, an interview with an expert of the field allowed to better understand the reality. Based on R&D intensity over 2010-13, the author suggests that Solvay has lower levels of R&D intensity than benchmarks. Moreover, Agfa-Gevaert is an exception, since has been trying to change its strategy focus which, eventually, requires higher investments on R&D.

5.5 Acquisitions

5.5.1. Introduction

This chapter is devoted to understand if growth differences between selected firms were caused, partially, by firms' acquisitions. Note that the main focal point of the scholars is oriented to understand if acquisitions have a positive impact on organic growth, in order to understand if acquisitions usually result in synergies. However, in this thesis, the focus is on acquisitions' impact on overall growth. Ideally, one should understand if: *i)* benchmarks are more able to capture synergies with acquisitions, supporting their higher growth; *ii)* benchmarks are investing more heavily in acquisitions, which would result in higher growth due to consolidation reasons. However, no such data is available. I.e., no data was found concerning impact on organic growth. Thus, the analysis will be performed taking into account the level of acquisitions of each firm (to which extent firms are investing in acquisitions) and its impact on overall growth. Regardless the impact on organic growth, it is important to understand if acquisitions enhanced benchmarks' growth *vis a vis* rest of the firms' growth. In fact, as identified in (Delmar et al., 2003), there are firms growing only through acquisitions, with a negative organic growth.

In this context, Section 5.5.2. addresses the selected metric to quantify each firm's acquisition level and the data collection process. Section 5.5.3. is devoted to understand if acquisitions had an impact on firms' growth. For this, let's consider Hypothesis 5a.

Hypothesis 5a: Acquisitions are positively correlated with growth for the set of firms under analysis and over the period 2002-13.

Note that due to consolidation issues, it is expected a significant impact of acquisitions on firms' growth. Nevertheless, there is also the probability of negative effects caused by acquisitions, such as lack of financial resources to invest in already existent business activities, which can cancel growth benefits coming from acquisitions. In this way, there is a need to prove that acquisitions had an impact on firms growth (correlation does not prove, but suggests).

Second, Section 5.5.4. is dedicated to understand if benchmarks invested more heavily on acquisitions, suggesting the reason behind their additional growth. In this context, let's consider Hypothesis 5b.

Hypothesis 5b: Acquisitions are distinguishing benchmarks from the rest of the firms, with benchmarks presenting higher investments in acquisitions over the period 2002-13.

5.5.2. Metric Selection and Data Collection

Concerning the metric for this growth driver, Kumar (1985) measured acquisitions levels through expenditures on acquisitions of new subsidiaries as a proportion of acquirer's size (assets) in the previous year of such acquisition. A similar approach was followed: quantify acquisitions in relative terms to acquirer's size. Two slightly differences can be noticed comparing to the referred work. First, size will be measured by sales, to go in line with the rest of the thesis. Second, the authors do not specify concretely what is expenditures on acquisitions. The author suggests that one suitable metric is data concerning the total purchase prices per year. Purchase price takes into account the real value of a firm (i.e. concerning assets and liabilities), and also a goodwill often related with possible synergies. Generally, it is indeed a suitable metric because the higher the purchase price, the higher the acquirer's investment on such acquisition. So, the selected metric concerns the total purchase prices per year. When no such data was available, a estimation was done using the value stated by a headline of the cash flow statement: usually denoted by "Payment Related to Acquisitions" or "Acquisition of Subsidiaries, Net Cash". The main difference between this headline and the total purchase prices per year is that the former refers to net cash flow, so it is the purchase

price less/plus the cash acquired/disposed with the acquisition. This is a limitation. However, usually the difference is residual, so it can be considered as a realistic estimation.

Concerning the sources of data, purchase prices of subsidiaries are often undisclosed data. Databases such as Zephyr and Mergermarket have a list of acquisitions per firm with information such as year of acquisition and purchase prices. Nevertheless, even crossing data, a significant number of deals have undisclosed purchase prices. A estimation based on such numbers would be unrealistic. Hence, the process of data collection was mainly based on annual and financial reports (that often present the total of purchase prices per year, not per acquisition).

In the end, it was possible to quantify in a realistic way the acquisition levels of each firm, with data over the period 2003-2013. Two main limitations were found. First, Floridienne just states such data over the period 2008-2013. Because of this, during the data analysis, an unbalanced data panel will be used. Second, The Dow Chemical Company does not present such information in the reports. To overcome this issue, a estimation was done through crossing data using Zephyr and Mergermarket data bases. This is the main limitation of this work. However, normally, these data bases have data concerning the larger acquisition deals, which reduces the impact of this limitation. For details about the data, please see Annex 7.

5.5.3. Testing Acquisitions' Impact on Growth

Hypothesis 5a will be tested through a panel data. The author opted to use a static version of the panel data model employed in (Lockett et al., 2007). The linear regression equation is expressed by Eq. 9.

$$Growth_{i,t} = \beta_0 + \sum_{j=0}^{j=3} \beta_{j+1}\alpha_{i,t-j} + \beta_4 control_{i,t-1} + \varepsilon_{i,t} \qquad \text{Eq. 9}$$

, where i refers to the firms; t to the year (between 2003 and 2013); β to parameters; $control$ to control variables, namely firms' size, year dummies (mainly because of macroeconomic fluctuations denoted during the financial crisis of 2008); $\varepsilon_{i,t}$ to the usual error term; $Growth$ is calculated as in Chapter 5.2.; α to the acquisition levels, with a lag period of 1, 2 and 3 years following (Eq. 4).

$$\alpha_{i,t} = \frac{Sum\ of\ Purchase\ Prices_{i,t}}{Sales_{i,t-1}} * 100 \qquad \text{Eq. 10}$$

For the sake of simplicity, descriptive statistics are presented in Annex 7. Hausman test (Annex 7) suggested the application of the fixed effects model. Statistical results are presented in Table 4.

Table 4 Regression Results for Fixed Effects Model **Source** Performed in R Software

	Estimate	**Std. Error**	**t-value**	**Pr (>| t |)**
Acquisitions (t)	0.24791	0.20725	1.1962	0.238037
Acquisitions (t-1)	0.48591	0.19514	2.4900	0.016624*
Acquisitions (t-2)	0.30187	0.19223	1.5704	0.123483
Acquisitions (t-3)	0.17393	0.32509	0.5350	0.595336

Notes: This table shows the regression results for Eq. 9; size of the firms and year dummies are used as control variables but not reported. R-Squared=0.38411. p-value=0.0010941. *Significant at 5% level ** Significant at 1% level *** Significant at 0.1% level.

Concerning statistical results, the following remarks can be done:

i) $\alpha_{i,t-1}$ is significantly and positively correlated with $Growth_{i,t}$, with a *p-value*≈1,7%<5%, suggesting that acquisition levels have usually a positive impact towards growth in the year after the acquisition (e.g., if the acquisition takes place in 2010, growth between 2010 and 2011 will be affected, so probably due to consolidation issues).

ii) the estimation for β_1 presents a value of $\beta_1^* \approx 0.49$, which means that, in average, a variation of 1% in the acquisition level will cause a variation of 0.5% in firm's growth.

In this sense, Hypothesis 5a is supported. Based on this, the author believes that acquisitions had a positive impact on firms' growth. In terms of limitations, note that the statistical test was done with data related to the period over 2003-13. So, one should not generalize the results for the period over 2002-2013. Lastly, another important limitation concerns the data, since

for some values the purchase price was estimated through the net cash flow of the acquisition deal (see Annex 7).

5.5.4. Testing Acquisitions as Distinguishing Growth Driver

The next step should be to understand if benchmarks are engaging more in acquisitions when comparing to the rest to the firms. To do this, the average of the yearly acquisition levels over the period 2002-13 will be used. Figure 19 shows the results of such calculations.

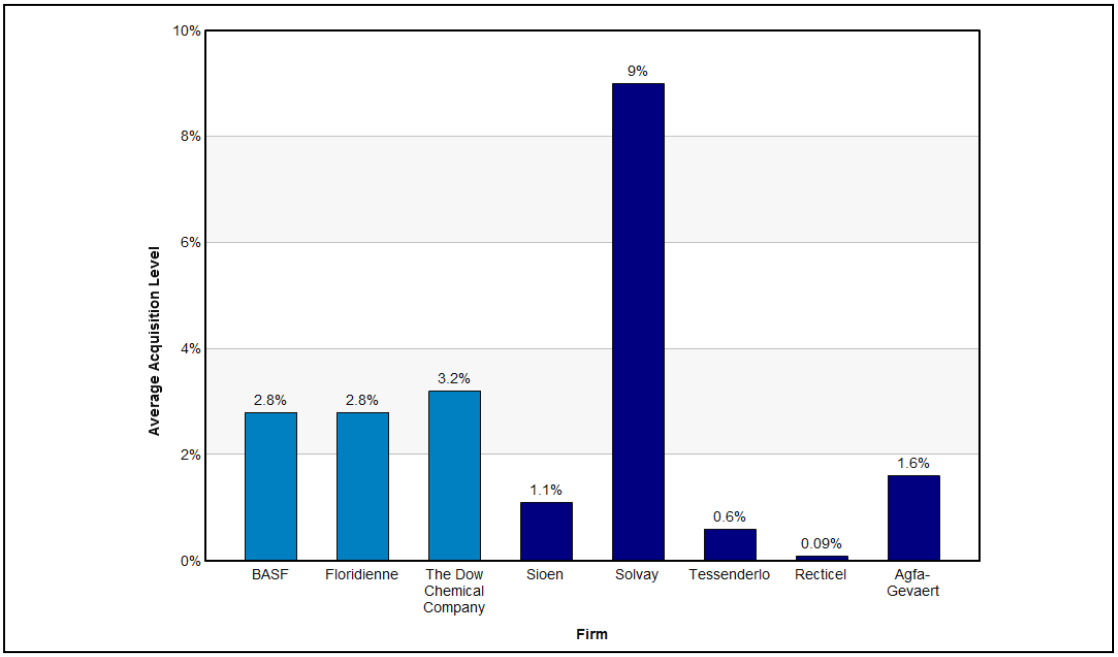

Figure 19 Average Acquisition Level per Year [2003-2013, % of Sales] (* for Floridienne a estimation was done considering the period over 2008-13) **Source** The Author based on BASF's, Floridienne's, The Dow Chemical Company's, Solvay's, Sioen's, Tessenderlo's, Recticel's and Agfa-Gevaert's Financial and Annual Reports, Mergermarket Data Base, Zephyr Data Base

As it possible to visualize, Figure 19 suggests that benchmark firms, in average, invested more in acquisition between 2003 and 2013, when comparing to the rest of the firms. The Dow Chemical Company presents the highest value *vis a vis* rest of the benchmarks, but the values are significantly similar within this group. Concerning the rest of the firms, excluding Solvay, values are significantly lower. On the one side, Recticel presents the lowest value, almost a residual one. One the other side, Agfa-Gevaert is the firm presenting the highest value (1.6%). Even with such status, Agfa-Gevaert's investments on acquisitions represent half of The Dow Chemical Company's investments.

Thus, in a general way, the author suggests that there is indeed a significant difference between benchmarks and rest of the firms in terms of acquisitions. However, there is an exception: Solvay. This is mainly due to the acquisition of Rhodia (in fact, in 2011 Solvay's acquisition investments represented more than 50% of sales). So, due to the exception of Solvay, the author considers that Hypothesis 5b is partially supported.

To conclude, an additional remark should be done. In fact, the analysis of the acquisition levels should be complemented with data relating to divestitures. This can help understanding if benchmarks' high levels of acquisitions are financed by the volume of divestitures. If this situation is true, one possible explanation for the positive correlation between acquisitions and growth is based on a superior benchmarks' performance on portfolio management: able to sell businesses with low growth rates and acquire more promising businesses. This could also provide more information concerning the paradox between Solvay's high investments on acquisitions and lower growth rates when comparing to benchmarks. One possible explanation for this is that Solvay has been presenting significantly higher values in terms of divestitures than benchmarks, overcoming the high values in terms of acquisitions and contributing to lower growth rates. Regarding this issue, unfortunately, no comparable data was found.

5.6. Conclusion

At this point, all the hypothesis were assessed. Note that this assessment was done not only through a quantitative approach, but also based with insights provided by an expert of the field, which enhanced the reliability of the findings. Henceforth, one can now try to answer the following question: "Why did benchmarks outgrow the rest of the firms over the period 2002-13?". For this, Table 5 presents the main results of the overall analysis performed in this part.

Table 5 Overall Results of the Analysis of the Relevant Growth Drivers (*n/a=not applicable) **Source** The Author

Relevant Growth Drivers	Hypothesis	Evaluation	Correlation with Growth	Note
Profitability	1a	Supported	+	+1%→+0.9% of Growth
	2a	Partially Supported	n/a	Exception: Solvay
Dividends	1b	Not Supported	+ (not clear)	
	2b	Not Supported	n/a	
Internationalization	3a	Not Supported	n/a	Europe with Highest Impact
	3b	Not Tested	n/a	
	3b*	Supported	n/a	Exception: Lack of Data for Sioen & Only European Firms
Innovation	4a	Not Supported	Not Correlated	
	4b	Partially Supported	n/a	Exception: Agfa-Gevaert
Acquisitions	5a	Supported	+	+1%→+0.5% of Growth
	5b	Partially Supported	n/a	Exception: Solvay

Concerning profitability, the statistical results supported a positive correlation between growth and profitability. In this context, the author suggests the fact that more profitable firms were more likely to grow over the period 2002-13. Moreover, it was possible to see a clear distinction between benchmarks and rest of the firms in terms of profitability. In fact, note also that BASF, Floridienne and The Dow Chemical Company were able to achieve higher levels of profitability even presenting higher values in terms of R&D intensity than the rest of

the firms. This support the idea that BASF, Floridienne and The Dow Chemical Company, in general, are significantly more efficient than the rest of the firms. The unique exception to this is Solvay that, even without the capital gains from the divestiture of pharmaceutical activities, was able to present high profit margin levels. Nevertheless, one can suggest that benchmarks grew more over the period 2002-13 due to, partially, higher profitability. Additionally, the impact of profitability, according to the fixed effects model, is significant: +1% in terms of profit margin increase in +0.9% sales growth. Despite the limitations of such reasoning, the author believes that profitability explains a significant part of growth differences.

Note that one can state that BASF and The Dow Chemical Company presented higher profit margins due to economies of scale. However, Floridienne and Solvay, specially Floridienne since is much smaller, were able to present good levels of profitability[1]. Even if economies of scale enhanced firms' profitability, this suggests that economies of scale are not the unique path to high levels of profit margin.

Regarding dividends, statistical results were against the expectations. Dividend payout ratio with a lag period of 2 years was shown to be positively correlated with growth. However, due to a high standard deviation and a negative correlation between dividend payout ratio with a lag period of 1 year and growth, the author suggests that the impact of dividend payout ratio on growth is not clear. Moreover, when analyzing differences between benchmarks and the rest of the firms, no clear pattern was acknowledged. In this sense, dividend payout ratio is not likely to be one reason supporting growth differences between benchmarks and the rest of the firms.

Thus, if growth differences between benchmarks and the rest of the firms were expected to be caused, partially, by firms' investments on the business, one can suggest that such investments depended mainly on firms' net income, rather than on dividend payout ratio.

Concerning international activity, despite the boom of the Asian market, most part of the growth was driven by the European market (specially for European firms, so excluding The Dow Chemical Company). Trying to understand why benchmarks outgrew the rest of the firms, there is a quite clear pattern: while European benchmarks grew in Europe over 2002-13, most of the rest of the firms suffered sales decline in Europe. The unique exception was Sioen that, due to the lack of data, no expressive results were found. Nevertheless, the question is: is Europe a problem? According to (CEFIC, 2013, 2014), sales in Europe over the period 2002-13 grew with a CAGR of 2.2%. Thus, Europe is not the problem: this suggests

[1] Excluding Floridienne's subsidiary bankruptcy.

that sales decline in Europe are mainly caused by firm-related features, rather than by macro-economic aspects.

Concerning innovation, two main findings were stated. First, no significant correlation was found between R&D intensity and growth. Second, there is a clear difference between benchmarks and rest of the firms in terms of R&D intensity (excepting Agfa-Gevaert due to particular reasons). In fact, even Solvay that, at a first glance, showed high levels of R&D intensity, after an analysis without the pharmaceutical activities, it was possible to understand that its R&D intensity is lower than benchmarks' levels. Summarizing these two points, since no correlation was found between R&D intensity and growth, one cann state that growth differences between benchmarks and rest of the firms are not caused, partially, by R&D intensity. However, due to statistical limitations, to the fact that R&D is considered to play a significant role in the chemical industry, and also because there is a difference between benchmarks and rest of the firms in terms of R&D intensity, the author suggests that R&D intensity should be high on managements' agenda.

Finally, even if benchmarks benefited from higher profitability levels, good performance in Europe and, maybe, higher levels of R&D intensity, part of their growth is suggested to be caused by higher levels of acquisitions: not only because acquisitions are positively correlated with growth, but also because there is a difference between benchmarks and the rest of the firms (excluding Solvay). Even if it is due to consolidation reasons, it is a growth driver. Within this matter, further research could be oriented to analyze divestitures. Maybe, benchmarks have higher acquisition levels because they also sell more businesses. If this situation is true, one possible explanation for the positive correlation between acquisitions and growth is based on a superior benchmarks' performance on portfolio management: able to sell businesses with low growth rates and acquire more promising businesses.

In this context, based on statistical results, comparison of metrics and insights from an expert of the chemical industry, growth differences between benchmarks and the rest of the firms are suggested to be a consequence of levels of profitability, sales performance in Europe and acquisition levels. Additionally, despite no significant statistical results, R&D intensity can also be an important growth driver. Among all the firms, the major exception of this analysis is Solvay that presents high levels of profitability and acquisitions (however, R&D intensity is lower than benchmarks and also presents a poor sales performance in Europe). Despite such exception, and to conclude, the author believes that this thesis provides a plausible answer to the question "Why did benchmarks outgrow the rest of the firms over the period 2002-13?".

6. Conclusion

The growth analysis of the selected Belgian firms in the chemical industry was done through a comparative analysis in the light of two well known chemical firms, namely BASF and The Dow Chemical. Given this, it was possible to understand two clear groups of firms: one that grew significantly more over the period 2002-13 (benchmarks); another one with lower and even negative growth rates (rest of the firms). In this context, the addressed problematic was precisely to understand the reasons behind such growth differences. In order to do this, a review of the *Growth as an Outcome* literature helped in listing a set of growth drivers that could affect firms' growth.

Later, with the support of an expert in the field, growth differences between benchmarks and the rest of the firms were hypothesized to be a consequence of: *i)* dividend payout ratio levels and profitability, since they can affect firms' financial resources devoted to invest on the business to foster further growth; *ii)* international activity, due to the boom of the chemical industry in Asia; *iii)* firms' innovativeness, given that innovation plays a significant role in the chemical industry; *iv)* acquisition levels, because of the numerous acquisition deals over the period 2002-13. Through a panel data model, it was possible to understand which were the growth drivers that are positively correlated with firms' growth over the period 2002-13. This analysis suggested the growth drivers that actually impacted firms' growth. After, based on a comparative analysis of growth drivers' metrics, it was possible to identify the growth drivers that distinguish benchmarks from the rest of the firms. In the end, it was argued that most part of growth differences were a consequence of benchmarks' (rest of the firms') higher (lower) profitability levels, better (worst) performance in Europe (and not Asia) and higher (lower) acquisition levels. Concerning innovation, despite no statistical evidence of its impact on growth, the author also suggested that this issue should be high on managements' agenda. This is not only because the expert identified R&D as a critical growth driver in the chemical industry, but also for the reason that there is a clear difference between benchmarks and rest of the firms in terms of R&D intensity.

With respect to this thesis's contributions, three interesting points should be stated. First, this thesis shows a possible application of the *Growth as an Outcome* literature towards a specific managerial problem: comparing two groups of firms and understanding the reasons behind their growth differences. One important point of such application is that, even with a careful data collection process, a quantitative approach should be complemented with an expert's point of view. This allowed to, e.g., comprehend why Agfa-Gevaert is engaging so heavily in R&D, despite its low growth rates. Second, taking into account the firm growth

literature and to the best knowledge of the author, a new potential growth driver was identified: dividends. Finally, in third place, this thesis also provides a plausible answer to a managerial problem described by the following answer: Why did benchmarks outgrow the rest of the firms over the period 2002-13?".

In terms of further research, two issues were raised. First, the analysis of the acquisition levels should be complemented with data relating to divestitures. Unfortunately, no data regarding this issue was found. Nevertheless, it would help understanding if higher acquisition levels of benchmarks are supported by capital gains from divestitures. Second, as already stated, dividend was addressed as a new potential growth driver. In this context, conceptual and empirical approaches could help analyzing the growth-dividends relation, relation which the author suggests to be non-linear.

A set of limitations should also be pointed to the findings of this thesis. First, concerning the explanation of growth differences, some exceptions were noticed. The main one is Solvay, which showed good profitability and acquisition levels even though not being a benchmark. Second, due to data availability issues, the statistical studies did not enclose all the years between 2002 and 2013. Third, concerning acquisitions, the total purchase prices were not always available, and the estimation of them through the headline "acquisition of subsidiaries" of the cash flow statement can be a limitation . Finally, in fourth place, panel data models can also imply a set of limitations. The most important one is that correlation does not imply causality. Thus, the assumption of the impact of a growth driver on growth based on their correlation is far from being an universal truth.

Regardless all these limitations, the author believes that the reasons behind most part of the growth differences between benchmarks and the rest of the firms were stated. To conclude, against Gibrat's Law perspective, this thesis suggests that *"Growth is never by mere chance; it is the result of forces working together"* - James Cash Penney.

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