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DIVESTITURES AND THEIR IMPACT ON THE INNOVATIVE CAPACITY OF FIRMS

In business practice divestitures are frequently observed, but often treated as side effects of corporate restructuring. However, divestitures can affect critical parameters on the firm level, such as the firm's innovative capacity. Research on the relationship between divestitures and the firm's innovative capacity has languished over recent years. Therefore, based upon the time period 1997-2007, this thesis has examined the relationship between divestitures and the innovative capacity of pharmaceutical firms. The research results found in this thesis empirically underline the positive effect of divestitures on the innovative capacity of pharmaceutical firms.

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After an educational period of nearly three years at the Erasmus University I can present my thesis. My thesis surrounds itself around a topic that has in economic research only infrequently been touched upon over recent years, but has proved to be of major relevance in both business practice and economic research. In thesis the impact of divestitures, as part of corporate restructuring, on a firm's research and development activities was examined.

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CHAPTER 1 INTRODUCTION

In business practice divestitures are frequently observed, but often treated as side effects of corporate restructuring. However, divestitures, a firm's adjustment and relocation of its resources through spin-offs, equity carve-outs, split-ups or unit sell-offs, are complex and high impact events. Not merely on the firm level (e.g. performance), but also on the macro level (e.g. industry concentration, size) and the individual level (e.g. motivation), divestitures affect critical parameters. Moreover, empirical findings on divestitures underline the major relevance of divestitures in business practice independent of firm size, scope, age and industry background (Hoskisson and Johnson,1992; Markides, 1990; Talley, 2003). Despite its major relevance, research on the effects and intensity of divestitures has languished over recent years.

To underline the intensity of divestitures in business practice, table 1 reports the number of divestitures for the sampling frame that has facilitated this thesis. The sampling frame, consisting of 190 firms with some operations in the pharmaceutical sector, reports for every year, except for 2007, more than 100 divestitures. From 2003 onwards most of these divestitures were related to the core activity of the firms, whereas the years prior to 2003 were characterized by relatively more unrelated divestitures.

Table 1 - Overview divestiture activity

Year	Total number of divestitures	Related divestitures	Unrelated divestitures	Divesting firms
1997	117	38 (32.5%)	79 (67.5%)	18.4%
1998	149	58 (38.9%)	91 (61.1%)	19.5%
1999	132	60 (45.5%)	72 (54.5%)	19.5%
2000	144	38 (26.4%)	106 (73.6%)	19.5%
2001	147	52 (35.4%)	95 (64.6%)	22.1%
2002	115	52 (45.2%)	63 (54.8%)	22.1%
2003	118	61 (51.7%)	57 (48.3%)	24.2%
2004	158	81 (51.3%)	77 (48.7%)	32.6%
2005	129	70 (54.3%)	59 (45.7%)	25.8%
2006	115	66 (57.4%)	49 (42.6%)	27.9%
2007	99	50 (50.5%)	49 (49.5%)	24.2%

The last column of the above table provides an insight into what percentage of firms in the sampling frame were involved in divestiture activity. From this column can be perceived that on

average 1 out of 5 firms were involved in divestiture activity, and in 2004 this number nearly reached 1 out of 3 firms. On the firm level divestitures feature similar levels of intensity, in terms of the deal values. For instance, Novartis and Bayer AG, both major players in the pharmaceutical sector, reported divestitures for no less than €5.4 and €4.6 billion, respectively, in their annual reports for the year 2007. The percentages reported in table 1 and the sheer size of the deal values stresses the need for further research into this field.

One of the critical parameters that can be affected by a firm's divestitures is its innovative capacity. Even though the concept of innovation is much debated over by economists, there seems to be agreement that innovation is an important source of economic growth (Narula and Zanfei, 2003). From the late 1980s onwards economic literature on divestitures and its relationship with the firm's innovative capacity expanded (Haynes et al., 2000). However, these findings often remain ambiguous and contradicting. For example, Hoskisson and Johnson (1992) found, due to a more efficient resource allocation, an increased research and development (R&D) intensity after business portfolio restructuring took place. On the other hand, Hitt and Smart (1994) found that firms divested business units to raise substantial cash flows to repay debts rather than making long-term investments in R&D. Nonetheless, the impact of divestitures on the innovative capacity of firms remain a topic of speculation in economic literature.

Building on economic literature and theories, this thesis examines the relationship between divestitures and the innovative capacity of firms. For this thesis a random sample of firms with some operations in the pharmaceutical sector has been drawn. This sector is characterized by relatively high levels of R&D and suits therefore this thesis' aim. The primary aim of this thesis develops into the following research question:

What effect do divestitures have on the innovative capacity of firms in the pharmaceutical sector?

In order to accurately measure possible effects of divestitures on the innovative capacity of firms, data for 190 firms in the sampling frame has been drawn for a period of 11 years, or for the period 1997 to 2007. In this manner the empirical results capture changes over time and the overall results are more accurate. The data on the innovative capacity and the various other underlying characteristics that facilitates this thesis have been retrieved from Thomson ONE Banker.

Following the introduction, this thesis proceeds as follows. Chapter 2 provides an overview on the term innovation. The term innovation is further explored and related to small and large firms. Various theories on divestitures and linkages to the innovative capacity of the firm are discussed in chapter 3. Moreover, the various hypotheses tested in this thesis are brought forward. Chapter 4 provides an overview of the pharmaceutical sector to date. The data and methodology underlying this thesis are set out in chapter 5. In chapter 6 the research results are depicted. Finally, chapter 7 presents the conclusions based up on the empirical results, limitations of this thesis and recommendations for further research.

CHAPTER 2 INNOVATION

Innovation is a term often used and related to economic growth, and stems from the reconfiguration of a firm's resources. As Karim and Mitchell (2004) noted, resource reconfiguration makes the firm to use its assets in different and new ways and provides the firm with innovative opportunities. Divestitures are a prominent modes of resource reconfiguration. In this section the term innovation is explored and conceptualized. Further, the role innovation has on both the macro and micro level as well as its strategic importance is highlighted.

2.1 THE CONCEPT OF INNOVATION

Among the first in the economic literature to address the term innovation was Schumpeter (1934). His notion of the carrying out of 'new combinations' refers to the introduction of a new good, the introduction of a new method of production, the opening of a new market, the access to a new source of supply and the carrying out of a new organization in any industry. Schumpeter's theory focused on the influence of market power on innovation. Further, innovation does not only lead to new and superior products and processes, it simultaneously undermines market positions of firms committed to inferior products and processes. Schumpeter defined this dynamic process as 'creative destruction'. Along these lines, Schumpeter argued that firms holding monopoly power must exercise their power cautiously in both price and product policy, otherwise they stimulate competitors in innovative activities which can undermine the position of the monopoly firm. All in all, Schumpeter clearly defined innovation, the disequilibrating effect on market positions and the destructive force of innovation.

However, the accelerating pace of technological advancement increases the importance of product of process innovation has called for a more contemporary definition of innovation. Luecke and Katz (2003) defined innovation as follows:

"Innovation… is generally understood as the successful introduction of a new thing or method… Innovation is the embodiment, combination, or synthesis of knowledge in original relevant, valued new products, processes, or services."

Regardless of the fact that the aforementioned definition of innovation is clearly conceptualized, the term innovation is often misused and linked to invention. Therefore, a clear distinction between these concepts should be made. Whereas invention reflects the occurrence of an idea

for a new product or process, innovation embodies the application of an invention in an actual product or process (Fagerberg, 2003).

2.2 FIRM SIZE AND INNOVATION

The relationship between firm size and innovation has been subject to a considerable debate. Schumpeter (1939) was among the first to stress that the independent, small scale, entrepreneurial type of firm was the driving force behind innovation. Later Schumpeter (1942) revised his views and argued that it was the large and established firms that were the most effective innovators. Schumpeter backed this argument by highlighting the relationship between innovation and a perfectly competitive market structure. According to Schumpeter (1942), a perfectly competitive market structure is incompatible with firm innovation, since this market structure does not provide the innovator with sufficient returns to justify R&D investments. Thus, concentrated industries are more innovative than competitively structured industries. Galbraith (1952) paralleled Schumpeter's line of thought by stating that innovation has become so costly that only large firms with necessary financial resources are capable of successful innovation. Besides the financial resources, large and established firms have built up a reputation and are therefore better able to exploit the benefits from innovation (Nelson, 1959). In other words, the value of innovative output may be greater for the large firm with well-developed distribution, marketing and sales channels.

Albeit may seem that large established firms in concentrated industries are more innovative and better able to exploit benefits from innovation than small firms in competitively structured markets, economic literature does provide ample counterarguments in favor of small firms. For one, a firm in possession of monopoly power may be less intrigued to innovate, since it feels less exposed to changes in market structure and rivals (Scherer, 1980). Along these lines Arrow (1974) argued that these firms are less innovate, because sales of new products may be at the expense of the sales from existing products, the so-called replacement effect.

Furthermore, established firms keep using old assets, since the cost of new and more efficient assets is greater than using less-efficient assets. In addition, Mansfield (1968) noted that in large firms more people are involved in the decision making process which may lead to managerial coordination inefficiency and loss of flexibility. Further strengths of small firms lie in behavioral characteristics. Small sized firms exhibit more efficient communication and higher levels of motivation of management and employees, due to intertwined ownership and management (Nooteboom, 1994; Rothwell and Dodgson, 1994). Based upon the foregoing it

can be concluded that the economic literature is inconclusive on the role between firm size and innovation.

2.3 IMPORTANCE AND MEASUREMENT

In spite of the fact that many views on and definitions of innovation are present, innovation is widely regarded as an important source of economic growth (Narula and Zanfei, 2003). Innovations are essential in facilitating new product entries to the market and more efficient production processes, thereby creating economic value on both the macro level and micro level. Strengthened by the pace at which the economy evolves and the globalization trend in which borders vanish and firms face more competitive markets, innovation has become an important strategy to sustain and create a competitive advantage on the micro level. Along these lines Franko (1989) stated that innovation is an important outcome of firm processes and has been shown to be critical for firm performance, especially in industries with global competition. Moreover, Franko (1989) argued that low relative R&D expenditures by American firms compared to both European and Japanese firms in the 1970s resulted in losses of market shares for American firms in a wide array of industries. In addition, a more recent publication by Deloitte (2005) underlines the importance of innovation. Due to changing consumer demands and competitive offerings, products representing in 2004 over 70 percent of a firms' sales will be obsolete by the year 2010. In other words, innovation is a vital means for firms to survive. Paralleling this findings by Deloitte (2005), Davila et al. (2006: p6) note:

"Companies cannot grow through cost reduction and reengineering alone… Innovation is the key element in providing aggressive top-line growth for increasing bottom-line results."

It may thus be concluded that innovation is an important determinant of economic growth in the contemporary economy. However, innovation remains an ambiguous term and difficult to grasp and measure. Therefore, research on the innovative capacity of firms by Baysinger and Hoskisson (1989) and Hitt et al. (1996) focused on the relative expenditures on R&D as a proxy for the innovative capacity of firms. Even though this measure for innovation may fall short on several occasions, some firms may be more efficient in R&D, thereby having more innovations for similar or even lower investments, empirical results support this measure to capture the innovative capacity of firms. For instance, Mansfield (1968) and Scherer (1984) found a strong positive relationship between R&D intensity and the total number of innovations. In addition, Acs and Audretsch (1988) demonstrated a positive relationship between a firm's R&D intensity

and its innovative output. For these reasons this thesis used relative expenditures on R&D as a proxy to measure the innovative capacity of firms.

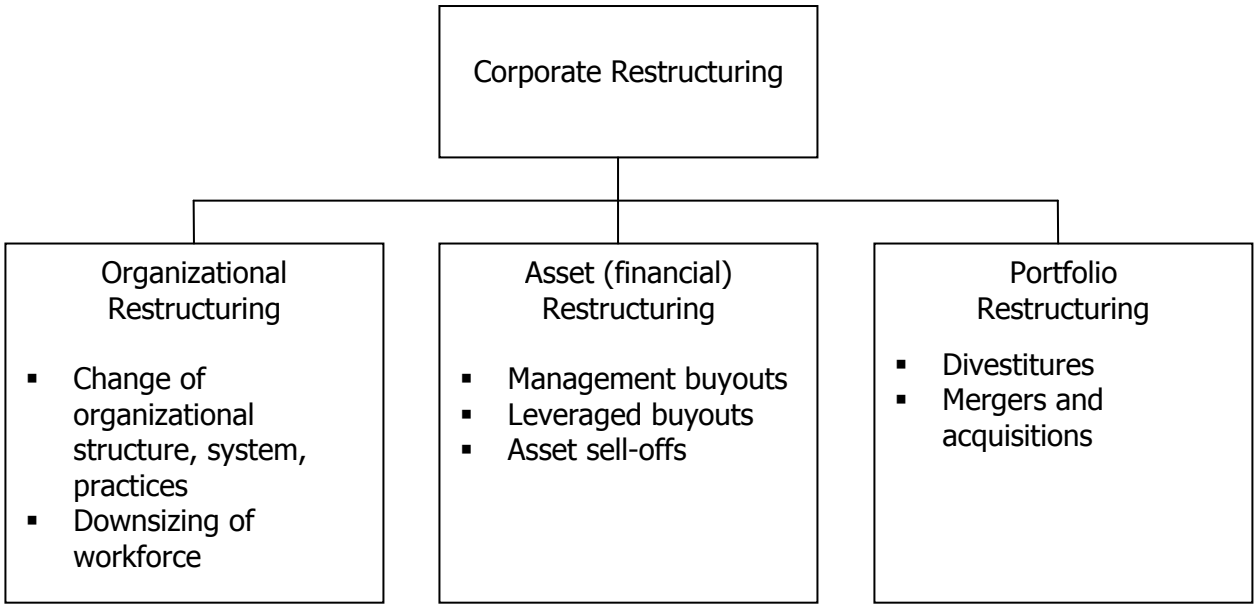
CHAPTER 3 DIVESTITURES

Divestitures, the firm's adjustments and relocation of its resources through spin-offs, equity carve-outs, split-ups or unit sell-off, are complex and high-impact events. For these reasons, divestitures are a vital part in every firm's corporate restructuring program. This chapter explores the role of divestitures within corporate restructuring. Moreover, empirical findings on the determinants of and previous research on divestitures are set out, which lead to the formulation of the hypotheses of this thesis.

3.1 CORPORATE RESTRUCTURING

Corporate restructuring can entail a wide array of transactions, including selling business lines, making acquisitions, changing the capital structure and changing the internal organization. Productivity enhancements, cost controls and other incentives designed to maximize shareholders' value are underlying motives for corporate restructuring. As depicted in figure 1 below, economic literature distinguishes between three forms of corporate restructuring, namely organizational restructuring, asset (financial) restructuring and portfolio restructuring.

Figure 1 - Corporate restructuring (Brauer, 2006)



First, organizational restructuring aims at improving the firm's efficiency and effectiveness through changes in the firm's internal organization. A common procedure to change the internal organization is a reduction in labor force. Second, asset (financial) restructuring includes management buyouts and the infusion of large amount of debts to finance leveraged buyouts

or to repurchase stock from equity investors. Last, business portfolio restructuring may occur through mergers and acquisitions, and divestitures. This form of restructuring aims at developing a new configuration of a firm's business lines. Although divestitures have proved to be of major relevance in business practice, independent of firm size, scope, age and industry background (Hoskisson and Johnson, 1992; Markides, 1990; Talley, 2003), research on divestitures really began in the 1980s (Haynes et al., 2000). The growing effectiveness of the market for corporate control disciplined managers and reduced the information advantages of multibusiness firm's internal capital market. As negative evidence against diversified firms augmented, capital markets took a critical stance toward diversified firms. Following the merger and acquisitions (M&A) wave in the 1980s, many firms began to reverse their unsuccessful M&A transactions. Firms were found to divest more formerly acquired businesses than they actually kept (Porter, 1987; Kaplan and Weisbach, 1992). Due to the aforementioned facts, throughout the 1980s divestitures gained crucial importance in business practice as the number and size of divestiture transactions increased.

3.2 DIVESTITURES AND ACQUISITIONS

The fact that many formerly acquired businesses were divested by firms in the 1980s led to the misconception that divestitures are the opposite of M&A transactions. This somewhat simplistic view was further encouraged by the assumption that a firm's divestiture automatically is another firm's acquisition (Buchholtz et al., 1999). However, this assumption does not take into account the different modes of divestitures. Spin-offs and split-ups, for instance, do not involve an external buyer, since the parent firm automatically becomes the shareholder of the independent new firm. Further, in case of a spin-off, the divested business unit's resources and competencies are valuable, however, managing the business unit is less effective under full ownership (Rose and Ito, 2005). An equity carve-out, on the other hand, entails the sale of a business unit through an initial public offering (IPO). From an operational perspective, the view that divestitures are mirror images of M&A transactions falls short on the aforementioned modes of divestitures and may only be applicable to divestitures through sell-offs. However, some basic differences exist. In contrast to M&A transactions, sell-offs are without exception deliberate actions made by the management of the divesting firm (Khan and Metha, 1996). Besides, the divesting firm has full discretion over the sell-off (Brau et al., 2003). For instance, the divesting firm seeks interested buyers, determines independently the deal's structure and determines autonomously which portion of the firm it would like to sell-off (Datta et al., 2003). Besides the full discretion of the divesting firm over the sell-off, the managers' perceptions, underlying incentives and the required tolerance for risk differ significantly from M&A

transactions (Duhaime and Schwenk, 1985). Moreover, according to Duhaime and Schwenk (1985), sell-offs are regarded as a 'divorce', while M&A transactions are associated with euphoria, illusion of control and hubris. For these reasons, divestitures cannot be dealt with as simple mirror images of M&A transactions.

3.3 STRATEGIC OPTIONS

The prevalence of firms divesting formerly acquired business units rather than strategic divestitures resulted in the misconception that divestitures are an admission of corporate failure (Boot, 1992). Rather than being perceived as a strategic option, divestitures were associated with reversing inappropriate prior investment decisions (Markides and Singh, 1997). However, divesting formerly acquired business units may not automatically be an indication of an inappropriate investment decision. Some acquired business units are included in an M&A transaction along with other business units and are thus part of the transaction. These business units are never meant to be included and hence divested shortly after the acquisition has been completed (i.e. cherry picking). For example, over the last years the pharmaceutical sector has seen many large M&A transactions that resulted in overlapping product portfolios for the merging firms or the acquiring firm. As a result the merging firms or acquiring firm divested the overlapping parts. Further, divesting formerly acquired business units may also be dependent on the desire of the firm to alter its corporate strategy due to changes in the marketplace, which were not apparent at the time the M&A transaction transpired (Weston, 1989).

Management surveys (KPMG, 2002), exploring the reasons behind divestitures, found that divestitures are perceived as a strategic option rather than being perceived as the reversion of an inappropriate investment decision, and are observed as competitive events in itself. The survey further underlines that divestitures can assist in growing the firm's core business, repositioning the firm, creating new businesses and optimizing the firm's resources, both tangible and intangible (KPMG, 2002; Dranikoff et al., 2002). The outcomes of a survey by Hamilton and Chow (1993) feature similar beliefs. Underlying motives for divestitures are the desire of the firm to grow its core business and exploit possible opportunities rather than reversing past investment decisions. Moreover, even a firm's most successful business unit may over time cease to perform as well as in the past. Therefore, firms must actively restructure their business portfolios in order to sustain competitive and ensure their positions in the market. In addition, the business unit's life cycle may necessitate frequent changes in ownership (Dranikoff et al., 2002). These insights further emphasize the strategic importance of divestitures (Dranikoff et al., 2002).

Although in business practice divestitures are often perceived as an admission of corporate failure, economic literature suggests the opposite. Rather than being perceived as strategic errors, divestitures are perceived as strategic options to realign the firm's business units and thereby grow the firm's core business.

3.4 DETERMINANTS OF DIVESTITURES

Business portfolio restructuring through divestitures are high impact events for a firm and serve to grow the firm's core business and the overall firm performance. However, determinants leading to the decision of a firm to divest a business unit have not yet been explored. Economic literature on the determinants of divestitures can be classified into two broad categories, namely sector specific determinants and firm specific determinants. These findings by scholars on the determinants of divestitures often remain ambiguous.

3.4.1 SECTOR SPECIFIC DETERMINANTS

Sector specific determinants are broadly defined in economic literature. The most common addressed determinants are technological change, environmental uncertainty, sector concentration, sector growth and sector regulation. For the degree of technological change both Harrigan (1982) and Jensen (1993) found a positive relationship, indicating that higher degrees of technological change increases product obsolescence. In particular, exogenous technological developments spur the number of exits of firms that are not capable of adjusting to the new technological requirements (Jovanovic and MacDonald, 1994). Paralleling the findings on the degree of technological change are the results on environmental uncertainty. Increased levels of environmental uncertainty posits higher divestiture activity of moderate and highly diversified firms, since the costs of managing a moderate or highly diversified firm increases in periods of high uncertainty (Bergh and Lawless, 1998; Chatterjee et al., 2003).

Although the findings on the degree of technological change and environmental uncertainty are not conflicting, the findings on sector concentration tell a different story. Empirical findings by Chang and Singh (1999) and Ilmakunnas and Topi (1999) imply that the rate of divestitures is lower for sectors with lower concentrations, since the firms face a greater opportunity to collude in times of low demand. Moreover, based upon a game theoretic model, Tan and Yuan (2003) suggest that high levels of competition spur divestiture activity by generating coordinated divestiture decisions among rival firms to soften competition. On the other hand, Hopkins (1991) argued that less concentrated sectors and unattractive domestic sectors are not related to an increased divestiture activity.

Empirical findings on the role of sector growth have remained similarly conflicting. Illmakunnos and Topi (1999) found that in periods of negative sector growth the rate of divestitures increased, while in periods of positive sector growth the rate of divestitures decreased as the chances of survival improved. On the other hand, Harrigan (1982) and Sembenelli and Vannoni (2003) found that during periods of positive sector growth multibusiness firms divested business units with a small market share and with a relatively small contribution to the overall performance of the firm in order to fully take advantage of the firm's core business.

Sector regulation (i.e. antitrust policy, deregulation and changes in tax regulations) have been found to be a major diver behind divestitures in the 1980s. Tax-free declarations of proceeds from divestitures, due to changes in the tax regime (e.g. United States and Germany), under certain conditions, have significantly influenced divestiture activity (Turk and Baysinger, 1989; Hoskisson and Hitt, 1990).

3.4.2 FIRM SPECIFIC DETERMINANTS

Regardless of the fact that sector specific determinants of divestitures described in economic literature significantly influence divestiture activity of firms, it are not the mere drivers behind divestiture activity. There are multiple reasons for firms to divest business units. Previous firm level studies on the antecedents of divestitures include poor firm performance, unrelatedness of business units agency problems and firm's debt position.

A strong predictor of divestitures is poor firm performance prior to the divestiture (Duhaime and Grant, 1984; Hoskisson et al., 1994; Johnson, 1996; Dranikoff et al., 2002). In order to restore economic efficiency and thereby firm performance, firms often opt to divest poorly performing business units. These poorly performing business units are often related to strategic errors made in the acquiring period. Roll (1986) linked these strategic errors to managerial hubris or an overvaluation of the managerial capabilities during the acquiring period.

Besides strategic errors made in the acquiring period, poor firm performance can also be the result of the unrelatedness of business units to the firm's core business. This unrelatedness of various business units can result in low interdependencies or negative synergies (Bergh, 1997; Harrigan, 1985; Hoskisson et al., 1994; Zuckerman, 2000). Therefore, excessive diversification can be a triggering device for divestitures (Bergh, 1997; Harrigan, 1987; Chang and Singh, 1999; Duhaime and Grant, 1984). Firms can diversify up to certain level. Beyond this level of diversification firms are unable to achieve economic efficiency, since resources cannot be

efficiently allocated, which in turn leads to negative synergies (Brauer, 2006). Moreover, in case of excessive diversification, managers can lose vision of potential synergies due to the degree of complexity. Bergh (1997) empirically showed that the greater the unrelatedness of a business unit, the more likely the business unit is divested.

Existing research has found a direct link between excessive diversification and inadequate internal governance (Hoskisson et al., 1994). Inadequate internal governance may lead to a divergence between the managers' and stockholders' objectives regarding the strategic orientation of the firm. In other words, agency problems can form a fundament on which excessive diversification can flourish. Therefore, effective ownership (e.g. inside director ownership and blockholder equity) can be a correction mechanism for firms that are unable to restrain diversification. Hoskisson et al. (1994) and Chatterjee et al. (2003) both found divestiture intensity to be directly and positively related to inside director ownership and blockholder equity.

The last underlying antecedent of divestitures brought forward in economic literature, is a firm's debt position. Various studies have shown a significant relationship between a firm's relative debt position and divestiture intensity (Hoskisson et al., 1994; Scherer, 1988). In other words, high relative debt triggers divestitures in order to repay debt costs. Often this results in little or no long-term strategic commitments, such as R&D investments (Hitt and Smart, 1994).

From the aforementioned can be concluded that divestitures are not merely determined on the sector level, but on the firm level as well. However, empirical findings on some determinants remain ambiguous.

3.5 DIVESTITURES AND R&D

Despite the fact that research on divestitures has languished over recent years, previous empirical results provide ample motives for firms to divest business units or portions thereof. Nonetheless, divestitures in relation to the firm's innovative capacity has remained subject to a considerable debate. However, the presented empirical results hint at a positive relationship between a firm's divestitures and its innovative capacity.

The most prominent postulation in divestiture research is that divestitures are used to restore corporate efficiency. For that reason low overall firm performance prior to the divestiture has been found to represent the strongest predictor of divestitures. For instance, Ravenscraft and

Scherer (1987) found that a low overall firm performance often precedes a divestiture and conclude that poor performing business units are often related to acquisitions made in earlier years. Paralleling this line of thought, Porter (1987) showed that acquisitions often yielded unsatisfactory performance that in turn led to post-acquisition divestitures. Roll (1986) typified these strategic errors as managerial hubris or an overvaluation of managerial capability.

Regardless of the fact that low overall firm performance is related to acquisitions made in earlier years, Bergh (1997) found that the underperformance of the divested business units can often be linked to its unrelatedness to the firm's core business. This unrelatedness can result in low interdependencies and negative synergies among the various business units of the firm.

Closely linked to divesting unrelated business units is the firm's level of diversification. Firms diversifying through M&A transactions increase the overall degree of diversification of the firm. Consequently, high levels of diversification may lead to a divergence between the managers' and shareholders' objectives regarding the strategic orientation of the firm (Hoskisson et al., 1994). Therefore, firms divesting business units lower their degree of diversification and this may enable business-level managers and top management to gain more control and understanding over the existing product lines and business units. As a result, the firm can be monitored tighter and refocus itself on the long-term development of its core business by allocating resources more efficiently and effectively (Jensen, 1988). Empirical results by Hoskisson and Johnson (1992) demonstrate an increased R&D intensity after the portfolio restructuring has taken place. More recent studies by Capron (1999) and Van Beers and Sadowski (2003) underline these findings by concluding that divestitures can promote innovation.

Moschieri and Mair (2003) argued that in some cases divestitures can be a vehicle of innovation, allow growth, wealth creation and even survival for the parent firm. Spin-offs, for example, allow the parent firm to retain connections with the divested business-unit. The spun-off firm is smaller, its manageability enhances, adequate strategic controls increase managers risk propensity and the spun-off firm can be monitored more effectively by stakeholders (Hoskisson and Johnson, 1992). Besides, the spun-off firm can overcome obstacles the parent firm experiences, such as organizational inertia and relying on existing, less-efficient assets. In other words, the divested business unit can pursue innovative opportunities. Since the connections are retained, the parent firm can benefit from the assets, competencies and knowledge developed by and within the divested business units (Ito and Rose, 1994). The

aforementioned reasons suggest a positive relationship between divestitures and a firm's relative R&D intensity.

Hypothesis 1: A positive relationship exists between divestitures and a firm's R&D intensity.

3.6 LEVERAGE AND R&D

Hitherto, empirical findings hinting at a positive relationship between divestures and a firm's relative R&D intensity have been put forward. Nevertheless, an important underlying determinant of divestitures is a firm's relative debt position, or its leverage. Based upon empirical findings, Hoskisson et al. (1994) and Scherer (1988) argued that firms divest poor performing business units to raise cash flows in order to repay debts. During the process of divestitures, managers often postpone long-term strategic investments, such as R&D investments (Hitt and Smart, 1994). Besides, in most cases the firm's debt position does not allow the firm to engage in long-term strategic investments. In other words, a firm's relative debt position triggers divestitures and may, as a consequence, negatively moderate the relationship between divestitures and a firm's R&D intensity.

Hypothesis 2: A firm's relative debt position has a negative moderation effect on the relationship between divestitures and R&D intensity.

3.7 DIVERSIFIED SCOPE AND R&D

A primary means through which firms diversify are acquisitions (Hitt et al., 1996). Acquisitions may add whole firms, multiple businesses in different markets or significant numbers of new assets to the existing portfolio of the acquiring firm. Moreover, each acquisition has its own characteristics and, in many cases, own critical success factors. In any case, diversification through acquisitions imply both an increase in the number of business units the top management has to monitor and manage, and in complexity. Consequently, acquisitions result in higher information processing demands, may change the center of gravity drastically (Galbraith and Kazanjian, 1986) and may demand a different set of internal controls for the acquiring firm (Hitt et al., 1996).

The possible necessity for a different set of internal controls is further strengthened by a lack of knowledge of the acquired business operations and markets, and may even lead to a control loss for the top management. A loss of control emerges when the top management is not sufficiently informed about internal operations and/or external environment of major businesses

(e.g. business units) (Ellsworth, 1983). Thus, as a result of bounded rationality, top management in highly diversified firms may be overloaded with information, which, due to the lack of knowledge, cannot be properly and accurately evaluated. This may result in an inadequate assessment on the performance of business-level managers by the top management (Williamson, 1975).

Two internal controls are related to the management of large firms, especially in diversified firms, namely: strategic controls and financial controls. Hoskisson and Hitt (1988) argued that internal controls can have a significant effect on a firm's internal development (e.g. R&D). Strategic controls mainly put an emphasis on subjective criteria to evaluate the performance of business-level managers and have a long-term characteristic (Gupta, 1987). To be able to set subjective criteria, a thorough understanding of the firm and its business activities of the top management is required. Further, since the criteria are mainly subjective, comprehensive information exchange between top management and business-level managers is essential (Hoskisson et al., 1994).

On the other hand, financial controls encompass an emphasis on objective criteria, such as return on investment, to evaluate the performance of business-level managers. In other words, top management formulates financial targets on which the performance of business-level managers is evaluated. However, this approach may fall short on several occasions. First, it requires the independency between various business units to effectively utilize the financial controls. If the interdependence between various business units is high this may prove a problem (Goold and Campbell, 1987; Hill and Hoskisson, 1987). Second, objective financial criteria, such as return on investment, emphasize a short-term focus and thereby relinquish long-term investments, such as investments in R&D. For example, if large investments have a long time horizon and above average risk profiles, business-level managers may forgo these investments in order to meet the financial criteria set by the top management. Thus, financial controls refrain business-level managers from long-term investments, even though these investments may be in the best interest of the firm. Further, business-level managers cannot diversify their employment risk. Therefore, undertaking risky investments (e.g. R&D) may place the business-level manager's future earnings at risk (Eisenhardt, 1985). For this reason, business-level managers may become risk-averse and prefer less risky investments with predictable outcomes (Yarrow, 1973). According to Rappaport (1978) and Hayes and Abernathy (1980), the competitive crisis in the U.S. in the 1970s can be explained by a too strong focus on

financial controls. This resulted in a lower commitment to innovation, thus fewer investments in R&D.

To sum up, in general top management of highly diversified firms have little first-hand knowledge of the sectors and markets the firm operates in. Therefore, top management of these firms may tend to focus primarily on financial controls (Ackerman, 1970; Hill and Hoskisson, 1987). To put it differently, highly diversified firms may change their internal controls from long-term strategic controls to short-term financial controls. The objective criteria belonging to the financial controls requires no extensive knowledge of business operations and markets, but may jeopardize the long-term perspective of the firm by foregoing investments in R&D. For these reasons it is expected that a negative relationship exists between the diversified scope of the firm and its relative R&D intensity.

Hypothesis 3: A negative relationship exists between the diversified scope of a firm and its R&D intensity.

CHAPTER 4 THE PHARMACEUTICAL SECTOR

Characterized by numerous various stakeholders, considerable involvement of national governments and a high degree of regulation aimed at achieving different objectives, the pharmaceutical sector posits a unique structure. The objectives of regulating the sector range from supporting innovation to keeping public expenditures under control and ensuring a high degree of public health. The protection of intellectual property rights (patents) to ensure continued innovation is essential, since the sector is R&D driven.

In the sector a distinction is made between "originator" and generic firms. The "originator" firms are active in research, development, manufacturing, marketing and supply of innovative medicines. Most innovative medicines are subject to patent protection that provide the innovating firm with a reward for the innovation and stimulates future research. However, when patent protection expires, the "originator" firms lose their exclusive rights and generic firms can enter the market with equivalent medicines to the original medicines at a lower cost (Weyzig, 2004). Consequently, this facilitates national governments in controlling the health budget, contributing to the overall consumer welfare and stimulating further innovation. Whereas "originator" firms engage heavily in R&D activities (on average 17 percent of their sales was spent on R&D during the period 2000-2007), R&D activity by generic firms is limited. In general, generic firms are smaller and often more regional in nature as opposed to the "originator" firms. Large generic firms supply a wide array of products and generate most sales from medicines equivalent to blockbuster products whose patent protection have expired (European Commission, 2008).

M&A transactions have since the early 1980s been a prominent feature of the sector. In recent years M&A activity has further increased with a total deal value of $61 billion in 2005 and $113 billion in 2006 (PwC, 2007). These events concerned mainly large multinationals, such as the latest big merger of Bayer and Schering in 2006. Nonetheless, many of these M&A transactions were accompanied by divestitures due to overlapping product portfolios and unrelated business units. Despite this dynamism in the pharmaceutical sector, the centre of gravity has remained the same over time. The largest firms are located in the USA, Europe and Japan. Below in table 2 the ten largest pharmaceutical firms are depicted. Striking is the fact that all these firms are located either in North America or Europe.

Table 2 – Largest firms ranked by market value in 2004 (in $ billion) (Weyzig, 2004)

Firm and country	Market value[1]	Sales	Net profit
Pfizer (USA)	262	45.2	3.9
Johnson and Johnson (USA)	149	41.9	7.2
Novartis (Switzerland)	116	24.9	5.0
GlaxoSmithKline (UK)	116	35.2	7.8
Merck & Co (USA)	97	22.5	6.6
Roche (Switzerland)	90	25.5	2.5
AstraZeneca (UK)	77	18.8	3.0
Amgen (USA)	76	8.4	2.2
Eli Lilly (USA)	74	12.6	2.6
Sanofi-Aventis (France)	60	17.8	1.9

To sum up, the pharmaceutical sector posits, with a high degree of regulation, significant involvement of national governments and various other stakeholders, a unique structure. Patents, on the one hand, stimulate "originator" firms to innovate. On the other hand, expired patents provide generic firms the opportunity to enter markets with equivalent medicines at lower costs. These aspects make the pharmaceutical sector an interesting sector. Moreover, empirical studies aimed at providing insights on the effect of divestitures on the firm's R&D intensity are sparse.

[1] (Number of shares) x (share price at 25-03-04)

CHAPTER 5 DATA AND METHODOLOGY

Empirical research requires an adequate methodology to form a proper dataset from which the results are drawn at a later stage of this thesis. In this chapter the data and the underlying methodology of this empirical research are presented.

5.1 DATA

The firms providing data for this study were drawn from Thomson ONE Banker. Based upon Global Industrial Classification Standard (GICS) code for the pharmaceutical sector only those firms qualified for the sample with some operations in the pharmaceutical sector. Further, the sampling frame consist of those firms that reported R&D expenditures each year from 1997 to 2007. This sector provides useful information on internal innovation and is characterized by relatively high levels of R&D expenditures. Additional information on divestitures and acquisitions was obtained from the *Mergers and Acquisitions* module in Thomson ONE Banker. This module provided information for each firm on both divestitures and acquisitions for the period between 1997 and 2007. Based on GICS code 3520, the pharmaceutical sector, a total of 190 firms out of 1267 firms had complete information on R&D expenditures for the sampling frame.

5.2 METHODOLOGY

The allocation of resources to R&D activities is not merely determined by divestitures, the diversification strategy or the acquisitions strategy of a firm. Although these strategies may influence a firm's spending on R&D activities, other economic factors may also influence those decisions. Therefore, the empirical analysis must be conducted within a well-specified model to isolate incremental economic effects on corporate level R&D intensity. The model at hand has been based on previous research conclusions on corporate level R&D spending. In this section the empirical model and the various variables of the model are introduced and defined.

5.2.1 EMPIRICAL MODEL

The time period for this study ranges from 1997 to 2007 and results in repeated observations of the firms in the sampling frame resulting in a panel data. The panel data permits to measure accurately the differences over time, since the combination of time series and cross-sections enhances the quality of research results. As this thesis is aimed at capturing the differences over time with accuracy, this thesis has opted for panel data analysis. Moreover, the firms in the sampling frame are selected on the basis of data availability for R&D expenditures. In other words, the sampling frame consists of only those firms that reported R&D expenditures over the

period under study, regardless of firm size. Hence, since the firms were randomly selected for analysis from all pharmaceutical firms, the inference is valid for all firms within the pharmaceutical sector. Therefore, this study has opted for the random-effects model.

In order to determine if divestitures are related to the innovative capacity of a firm, an empirical model has been formulated. This empirical model has been based upon previous research in this field by Hitt et al. (1996). The formula used in this thesis is as follows:

$$\textit{R\&D intensity}_t = \beta_0 + \beta_1 \cdot \textit{Divesiture}_t + \beta_2 \cdot \textit{Leverage x divestiture}_t + \beta_3 \cdot \textit{Diversified scope}_t + \beta_4 \cdot \textit{Acquisition}_t + \beta_5 \cdot \textit{Liquidity}_t + \beta_6 \cdot \textit{Leverage}_t + \beta_7 \cdot \textit{Firm performance}_t + \beta_8 \cdot \textit{Firm size}_t + \beta_9 \cdot \textit{Average sector R\&D intensity}_t$$

where t is time, β_0 is the intercept and β_1 is the exposure to the variable *Divesture*, β_2 is the exposure to the variable *Diversified scope*, β_3 is the exposure to the variable *Acquisition*, β_4 is the exposure to the variable *Liquidity*, β_5 is the exposure to the variable *Debt position*, β_6 is the exposure to the variable *Firm performance*, β_7 is the exposure *Firm size* and β_8 is the exposure to the variable *Average sector R&D intensity*. Each (in)dependent variable is explained in the remaining part of this chapter.

The hypotheses are tested by a two-sided Student t-test. The levels of significance defined are 10%, 5% and 1%. The betas are tested on significance by the hypotheses:

$H0: \beta_n = 0$ $\qquad$ $n = 1, 2... 8$

$H1: \beta_n \neq 0$

Divestitures are complex and high impact events. The effects of these events on the firm's R&D intensity are not expected to be entirely observable within the same year. Therefore, this thesis has lagged the independent and control variables by one year in order to examine the effect on R&D intensity. Next to the one-year lagged models, this thesis has taken a three-year average of all variables and lagged the independent and control variables by one year. Spurious effects of asset sales or other incidental events are thereby evened and the results should therefore be better able to capture the effects of the various variables on the firm's R&D intensity. The final models used in this thesis' research may deviate from the aforementioned formula.

5.2.2 VARIABLES

The empirical model consists of different kinds of variables. The dependent variable, R&D intensity, is the event studied, whereas the independent variables are expected to affect the dependent variable. Besides the dependent and independent variables, the model contains several control variables to clarify the relationship between the dependent and independent variables.

5.2.2.1 DEPENDENT VARIABLE

R&D intensity, the dependent variable used in this thesis, was measured as a firm's reported expenditures on R&D activities relative to its sales. This variable to measure the innovative capacity of firms is the most commonly used variable in economic literature (Baysinger and Hoskisson, 1989). Nevertheless, R&D intensity is not a perfect measure of innovation in a corporate setting. For instance, large firms tend to have lower levels of R&D intensity compared to small, entrepreneurial firms. Despite these differences, previous research by Mansfield (1968) and Scherer (1984) found a strong positive relationship between R&D intensity and the total number of innovations. In addition, Acs and Audretsch (1988) demonstrated a positive relationship between a firm's R&D intensity and its innovative output. Regardless of these empirical findings, the dependent variable used in this thesis was only meant to measure the intensity of investment in inputs supporting the innovation process.

5.2.2.2 INDEPENDENT VARIABLES

Divestitures. The effect of divestitures on R&D intensity were determined using (1) a dummy for divestitures, (2) divestiture intensity, and (3) the relatedness/unrelatedness of the divestiture. The dummy for divestitures examined whether a divestiture had an effect on the firm's level of R&D intensity in general. Divestiture intensity, on the other hand, entailed the number of business units divested relative to sales for each year of the study. The relatedness/unrelatedness was determined by the three-digit SIC code for the primary industry by which each firm was classified in Thomson ONE Banker. These three different indicators allowed a more thorough analysis of the effect of divestitures on R&D intensity.

Leverage and divestitures. Previous research argued that a firm's debt position, or leverage, triggers divestitures in order to repay debts. In other words, divestitures are instigated by the firm's leverage and should therefore have a negative effect on the firm's R&D intensity. The effect of leverage and divestitures on R&D intensity was measured by multiplying the leverage and divestiture intensity for each year of the study.

Diversified scope. A firm's diversified scope expresses the level of specialization of the firm. In other words, a firm generating solely sales in a single sector has a high level of specialization or an undiversified scope, whereas a firm generating sales in many sectors has a low level of specialization or a diversified scope. The diversified scope of a firm was determined by a concentration ratio of the three-digit SIC code for the primary industry by which each firm was classified in Thomson ONE Banker. Thus, the concentration ratio reflects the degree of diversification of the firm for each year of the study.

5.2.2.3 CONTROL VARIABLES

Acquisitions. Agency problems, loss of managerial commitment to R&D and the absorption of managerial time and energy for firms pursuing an active acquisition strategy are motives to explain the negative relationship between acquisitions and R&D (Hitt et al., 1996). However, another strand of literature argues that throughout the 1990s acquisitions focused more on technological issues and the search for new technologies, thereby increasing the firm's knowledge base. This knowledge base, according to firm-level theories, is critical for the innovativeness of firms (Griliches 1984, 1990; Henderson and Cockburn, 1996) and results in a higher relative R&D intensity. To sum up, based upon empirical results, the relationship between acquisitions and R&D intensity remains ambiguous. Nevertheless, the empirical results in prior studies did demonstrate a relationship between acquisitions and R&D intensity. Therefore, the effect of acquisitions on R&D intensity is controlled for in the model by the number of acquisitions completed for each firm in each year of the study.

Liquidity. A firm's liquidity is positively related to the flow of funds available to support R&D activities. Despite whether these investments in R&D activities are desirable in supporting the competitive strategy of the firm, the ability to initiate these investments in the first place requires a strong financial position of the firm. Thus, the availability of financial resources enhances the capability of the firm to engage in R&D investments. Moreover, financial liquidity allows the firm to avoid borrowing in the open market, which reduces the cost of R&D investments to the internal opportunity cost of capital (McEachern and Romeo, 1978). A common economic measure to assess the liquidity of a firm is the current ratio. Therefore, to control for this economic variable, the current ratio of each individual firm for every year of the study has been included in the model. Current ratio is defined as current assets divided by current liabilities.

Leverage. In general high debts are associated with an enhancement in creditor control over strategy formulation. Therefore, a firm's relative debt position should be inversely related to the R&D activities it undertakes. In other words, a firm's debt position should influence its R&D intensity. In particular, when taking into account, the low probabilities of innovation success, the high associated risk with R&D activities and the amount of time required to provide adequate returns on R&D activities. Consequently, a weak debt position or leverage of a firm is negatively related to its R&D spending. Leverage is defined as the debt-to-equity ratio of the firm.

Firm performance. Economic reasoning suggests that high levels of firm performance positively influences a firm's R&D expenditures. In other words, high levels of firm performance is associated with an increase in the firm's financial resources. Despite the firm's strategy and whether R&D investments are desirable, high levels of firm performance enhances its ability to undertake R&D activities. To control for this economic variable in the model, firm performance is included. Firm performance is defined by the ratio return on assets (ROA), defined as sales divided by assets.

Firm size. Schumpeter (1961) hypothesized that large firms are more innovative than their smaller counterparts. Large firms have more sustained and efficient R&D programs. Moreover, economies of scale in R&D are more likely to be present in large firms, thus a higher efficiency, resulting in a higher innovative output for a lower investment for large firms. In addition, a large firm should have a greater capability to exploit innovations, since it should have a greater reach and more market power. However, Link (1980) argued that size is not necessarily contributing to R&D activities. Kamien and Schwartz (1982) found also contrary evidence to Schumpeter's hypotheses. Firm size and innovation is a nonlinear, inverse-U relationship. Although previous research has not been conclusive on the relationship between firm size and R&D, it has been shown that a relationship exists. Therefore, for the purpose of this thesis, firm size has been included in the model. Firm size is defined as the natural logarithm of total assets.

Sector R&D intensity. Firms active in R&D intensive sectors, such as the pharmaceutical sector, are more likely to engage in vigorous R&D activities. In these sectors of rapid change and progress, firms cannot forgo R&D investments, and therefore should participate in active R&D activities to sustain market share or to keep up with competitors. For these reasons, Jose et al. (1986) stated that a firm's R&D intensity is largely related to the average level of sector

R&D intensity. Based upon the findings by Jose et al. (1986), a positive relationship between a firm's R&D intensity and the average level of sector R&D intensity should exist. To control for this economic effect, the average level of sector R&D intensity is included in the model. Average level of sector R&D intensity has been defined as the average level of R&D intensity of all firms included in the sampling frame.

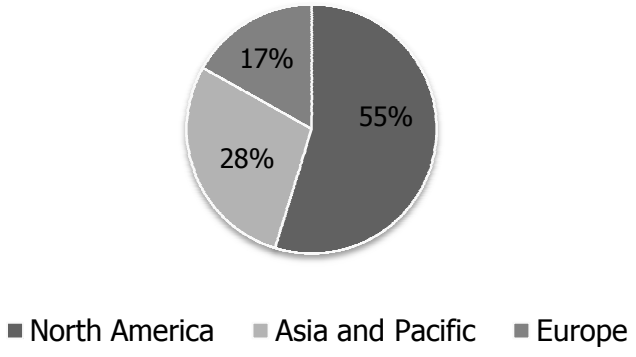
CHAPTER 6 RESEARCH RESULTS

In this chapter the empirical results of this thesis are presented. First, however, a glance is taken at the sampling frame and how American firms and non-American relate to one another in terms of R&D intensity. The correlation matrix explores the underlying correlations between the variables in the model. The correlation matrix is followed by the empirical results for both the model with a one-year lag and three-year average.

6.1 INDICATIONS

Figure 2 below depicts the structure based upon geographic region for the firms in the sampling frame. Immediately the large share of North American based firms becomes observable. The overrepresentation of North American firms may partly be explained by the prevailing accounting standards. The divergence on accounting for R&D expenditures between U.S. General Accepted Accounting Standards (GAAP) and the International Financial Reporting Standards (IFRS) is evident. Under GAAP, applied in firms originating from the USA, R&D expenditures are charged to expense when incurred. Under IFRS, however, an intangible asset arising from development is recognized if specific criteria, such as the technical feasibility of completing the intangible asset, are met. Based upon this divergence, critics argue that this an example of revenue/expense mismatching, since immediate expensing all R&D expenditures stress that writing off as an expense of the present period expenditures made with the expectation of benefiting future periods. Moreover, immediate expensing of all R&D expenditures may remove a firm's most valuable assets from its balance sheet (Gornik-Tomaszewski and Millan, 2005). Therefore, firms applying the IFRS accounting standards may be unable to report all R&D expenditures, since specific criteria have to be met. Hence, this divergence may partly explain the overrepresentation of firms originating from North America.

Figure 2 - Firms by geographic region



The divergence between accounting standards between American and non-American firms may trigger lower levels of R&D intensity for non-American firms. The results presented below in table 3 underscore this belief. The non-American firms demonstrate lower levels of R&D intensity when controlling for the firm's liquidity, leverage, performance and size.

Table 3 - American versus non-American firms[2]

	American vs. non-American
Intercept	3.869
	(19.06) ***
Non-American firms	-0.270
	(-4.10) ***
Liquidity	0.319
	(3.16) ***
Leverage	0.006
	(3.12) ***
Firm performance	-0.614
	(-16.98) ***
Firm size	-0.251
	(-10.79) ***
Adjusted R^2	0.395
N	1900

* p < .10 ** p < .05 *** p < .01

Thus despite the dramatic rise in global R&D expenditures in the pharmaceutical sector over the last 20 years, the levels of R&D intensity for non-American firms still fall short on their American counterparts.

6.2 CORRELATION MATRIX

Table 4 presents means, standard deviations and correlations among the variables used in this thesis. Analysing the correlation matrix illustrates initial evidence of good convergent and discriminant validity. Three out four correlations greater than 0.600 involve intrafactor correlations. The relatively low intercorrelations should preclude the generation of unstable and biased coefficients in the regression analysis.

[2] Appendix A reports the results controlled for autocorrelation.

Table 4 - Correlation matrix

Variables	Correlations											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. R&D intensity												
2. Dummy divestitures	-0.117											
3. Divestiture intensity	0.097	0.062										
4. Related divestitures	0.085	0.047	0.981									
5. Unrelated divestitures	0.074	0.086	0.200	0.005								
6. Leverage x divestiture	0.045	0.046	0.139	-0.001	0.717							
7. Diversified scope	-0.129	0.077	-0.017	-0.015	-0.015	-0.006						
8. Acquisitions	0.105	-0.028	-0.002	-0.002	-0.001	-0.001	0.015					
9. Liquidity	0.298	-0.105	0.144	0.137	0.050	-0.000	-0.031	0.018				
10. Leverage	-0.009	0.013	-0.003	-0.002	-0.003	0.010	0.049	-0.004	-0.008			
11. Firm performance	-0.607	0.103	-0.052	-0.040	-0.066	-0.038	0.173	-0.086	-0.292	0.017		
12. Firm size	-0.299	0.470	-0.041	-0.028	-0.070	-0.037	0.027	-0.068	-0.133	0.040	0.084	
13. Sector R&D intensity	-0.002	0.036	-0.014	-0.008	-0.031	-0.028	-0.017	0.001	-0.026	-0.025	-0.030	0.083

6.3 EMPIRICAL RESULTS

Since the effects of divestitures on the firms' R&D intensity may not be directly apparent, a lag has been applied to examine the relationship more accurately. In the subsequent parts of this chapter the empirical results are set out, compared to previous findings in economic literature and a comparison is drawn between the results of the various empirical models.

6.3.1 ONE-YEAR LAG

From table 5 below is readily observable that divestitures on all levels positively affect the firm's relative R&D intensity in the short-run. The dummy variable in model 1 illustrates these findings, indicating that divestitures in general positively affect the firm's relative R&D intensity. Divestiture intensity, representing the completed relative number of divestitures for each year over the period 1997 to 2007, underline these findings. At a 5 percent significance level, this variable shows that as the relative number of divestitures increases this positively affects the firm's relative R&D intensity.

Table 5 – One-year lag

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	3.846 (18.55) ***	3.781 (18.38) ***	3.753 (18.25) ***	3.769 (18.30) ***	3.719 (17.68) ***
Dummy divestitures	0.046 (1.78) *				
Divestiture intensity		0.026 (5.05) ***		0.025 (4.75) ***	
Related divestures			0.023 (4.37) ***		
Unrelated divestitures			0.106 (3.97) ***		
Leverage x divestiture				0.144 (1.87) *	
Diversified scope					-0.103 (-2.04) **
Acquisitions	0.027 (1.86) *	0.026 (1.84) *	0.027 (1.89) *	0.026 (1.85) *	0.024 (1.65) *
Liquidity	0.347 (3.43) ***	0.281 (2.79) ***	0.278 (2.76) ***	0.283 (2.81) ***	0.333 (3.30) ***
Leverage	0.006 (3.16) ***	0.006 (3.18) ***	0.006 (3.19) ***	0.006 (3.17) ***	0.006 (3.29) ***
Firm performance	-0.620 (-17.08) ***	-0.611 (-16.94) ***	-0.605 (-16.77) ***	-0.608 (-16.86) ***	-0.614 (-16.91) ***
Firm size	-0.279 (-11.61) ***	-0.271 (-11.41) ***	-0.269 (-11.33) ***	-0.270 (-11.36) ***	-0.273 (-11.45) ***
Sector R&D intensity	0.049 (1.81) *	0.051 (1.89) *	0.053 (1.97) **	0.052 (1.94) *	0.048 (1.78) *
Adjusted R^2	0.376	0.373	0.371	0.372	0.373
N	1900	1900	1900	1900	1900

* p < .10 ** p < .05 *** p < .01

Hitt and Ireland (1986) argued that the top management loses vision as the firm becomes more diversified. Therefore, one would intuitively expect that unrelated divestitures, those business units that are not related to the firm's core activity, positively affect the firm's relative R&D intensity. Table 5 underscores this expectation, unrelated divestitures positively affect a firm's relative R&D intensity. Paralleling the results for unrelated divestitures, related divestitures indicate a positive effect on a firm's relative R&D intensity. However, the coefficients indicate that the effect of unrelated divestitures is stronger than that of related divestitures. A possible explanation for the stronger effect of unrelated divestitures on R&D intensity is that the firm becomes more focused as it divests unrelated business units. Consequently, the stronger focus may result in a higher allocation of financial resources to R&D activities.

Based upon the significant positive effect of unrelated divestitures on the firm's R&D intensity and the notion that the top management loses vision as the firm becomes more diversified, one would expect that a diversified scope of a firm would negatively affect R&D intensity. Moreover, Hill and Hoskisson (1987) argued that firms with a highly diversified scope tend to focus primarily on financial controls which can have a detrimental effect on the R&D intensity of the firm. The empirical results reported in table 5 confirm earlier empirical results and illustrate that the diversified scope of the firm is negatively related to the relative level of R&D intensity.

In general high debts are associated with an enhancement in creditor control over strategy formulation. Therefore, a firm's relative debt position should be inversely related to the R&D activities it undertakes. In particular when taking into account the low probabilities of innovation success, the high associated risk with R&D activities and the amount of time required to provide adequate returns on R&D activities. The empirical results depicted in the table above demonstrate that a firm's leverage positively influences a firm's relative R&D intensity, underlining the earlier arguments.

Previous empirical results clearly demonstrate that prior firm performance positively affects current R&D intensity, as it determines a firm's financial ability to invest in R&D (Hitt et al., 1996; Baysinger and Hoskisson, 1989). Nonetheless, the research results found in this thesis suggest otherwise. A good firm performance does not result in firms engaging in higher levels of R&D intensity. On the contrary, a good firm performance results in lower relative expenditures on R&D. Despite these counterintuitive results, it may signal that the necessity to innovate decreases for pharmaceutical firms that perform well. Another explanation may be that relative R&D expenditures in the pharmaceutical sector are rigid and are thus not directly

affected by a good firm performance. Therefore, it may be concluded that a firm's relative R&D intensity is not dependent on firm performance in the short-run.

Schumpeter (1961) hypothesized that large firms are more innovative than their smaller counterparts. Economies of scale in R&D present in large firms would enable these firms to fully exploit innovations. Based upon this reasoning, Baysinger and Hoskisson (1989) argued that large firms should be more willing to invest in R&D. The empirical results demonstrate otherwise. At a 1 percent significance level for all models presented in table 5, firm size is negatively related to R&D intensity. This implies that as the size of the firm increases, the level of R&D intensity decreases. The negative effect of firm size on R&D intensity may be explained by hierarchical structures, managerial risk aversion and low entrepreneurial spirit present in larger firms (Moschieri and Mair, 2003). In line with these arguments, Dougherty (1979) argued that although larger firms posses more financial strength, these firms often reduce rather than promote R&D. Complementing these arguments, Collier (1983) stated that firms tend to become more formalized as they grow which in turn slows R&D activities.

To sum up, the empirical results imply that in the short-run divestures do have a positive effect on R&D intensity of firms active in the pharmaceutical sector. In particular the stronger effect of unrelated divestitures as opposed to related divestitures provide more insight into the relationship between divestitures and the firm´s R&D intensity. Besides the effect of divestitures on a firm's R&D intensity, firm performance provides counterintuitive results. The negative relation of firm performance on a firm's relative R&D intensity may indicate that a good firm performance decreases the necessity to innovate or that relative R&D expenditures are rigid for the firms in the pharmaceutical sector. Furthermore, firm size is negatively related to R&D intensity, indicating that an increasing firm size is negatively related to the level of R&D intensity.

6.3.2 ONE-YEAR LAG ROBUSTNESS

The quality of the empirical results presented in table 5 depends on the underlying assumptions of the empirical model. A prominent underlying assumptions of the used empirical model is autocorrelation. Since the data for this thesis has been collected on various firms over a longer period of time, the threat of autocorrelation in the presented results is luring. Therefore, table 6 reports the results when controlling for autocorrelation.[3]

[3] Besides autocorrelation, the research results have been analyzed when controlling for heteroskedasticity. Appendix B reports these research results.

Table 6 below reports the empirical results for the same empirical models presented in table 5. Divestitures remain to have a significant effect on the firm's relative level of R&D intensity. However, this effect appears smaller than in table 5. Moreover, no longer a positive significant effect of unrelated divestures on the firm's relative level of R&D intensity was found. Nevertheless, despite the smaller effect of divestitures on the firm's relative R&D intensity and the non-significant result for unrelated divestitures, the results on the effect of divestitures reported in table 6 are robust.

Table 6 - Controlling for autocorrelation

	Model 6	Model 7	Model 8	Model 9	Model 10
Intercept	3.386 (13.87) ***	3.351 (13.79) ***	3.352 (13.79) ***	3.350 (13.78) ***	3.333 (13.49) ***
Dummy divestitures	0.036 (1.86) *				
Divestiture intensity		0.014 (3.90) ***		0.014 (3.83) ***	
Related divestures			0.015 (3.93) ***		
Unrelated divestitures			0.004 (0.21)		
Leverage x divestiture				0.012 (0.23)	
Diversified scope					-0.025 (-0.51)
Acquisitions[4]	-0.035 (-3.21) ***	-0.035 (-3.25) ***	-0.036 (-3.28) ***	-0.035 (-3.25) ***	-0.037 (-3.35) ***
Liquidity[4]	0.335 (4.08) ***	0.315 (3.83) ***	0.316 (3.84) ***	0.315 (3.83) ***	0.329 (3.98) ***
Leverage	0.004 (3.16) ***	0.004 (3.09) ***	0.004 (3.09) ***	0.004 (3.09) ***	0.004 (3.08) ***
Firm performance	-0.308 (-8.68) ***	-0.306 (-8.65) ***	-0.307 (-8.66) ***	-0.307 (-8.65) ***	-0.307 (-8.64) ***
Firm size	-0.229 (-8.23) ***	-0.224 (-8.09) ***	-0.224 (-8.09) ***	-0.224 (-8.09) ***	-0.225 (-8.09) ***
Sector R&D intensity	-0.005 (-0.22)	-0.005 (-0.25)	-0.006 (-0.27)	-0.005 (-0.24)	-0.004 (-0.20)
Adjusted R^2	0.294	0.292	0.292	0.292	0.291
N	1900	1900	1900	1900	1900

* p < .10 ** p < .05 *** p < .01

Hoskisson et al. (1994) and Scherer (1988) argued that firms divest poor performing business units to raise cash flows in order to repay debts. Following this line of reasoning, a firm's relative debt position triggers divestitures and may, as a consequence, negatively moderate the relationship between divestitures and a firm's R&D intensity. The empirical results reported in

[4] The results on acquisition intensity and liquidity suffered from high levels of heteroskedasticity, therefore no conclusions can be drawn from these results.

table 6, however, does not provide a statistically significant result, therefore no conclusions on the effect of leverage and divestitures on R&D intensity can be drawn.

Whereas the findings of model 5 in table 5 report a statistically significant negative effect of the firm's diversified scope on its R&D intensity, the results depicted in model 10 are no longer significant. Therefore, no conclusions for the diversified scope of the firm in relation to R&D intensity can be drawn.

To sum up, the results reported in table 6 display similar outcomes on the relationship of divestitures and a firm's relative R&D intensity. However, no longer a significant relationship between unrelated divestitures and the diversified scope, and a firm's R&D intensity were found. Besides the results on divestitures and R&D intensity, both firm performance and size are negatively related to the firm's R&D intensity.

6.3.3 THREE-YEAR AVERAGE

Previously the results of the models using a one-year lag and the robustness of those results have been depicted, providing an insight into the relation between divestitures and the effect on the firm's relative R&D expenditures. Table 7 below reports the results for the models using a one-year lag. However, a three-year average has been applied to all variables in the different models. By taking a three-year average the variables are more stable and less sensitive to spurious effects of asset sales or other incidental events. The results presented in table 7 should therefore be better able to capture the effects of the various variables on the firm's R&D intensity.

The results reported in the table below demonstrate no significant relationship between divestitures in general and related divestitures in particular, and the firm's R&D intensity in the pharmaceutical sector. A possible explanation may be that by averaging the variables over a period of three years the effect of divestitures on the firm's R&D intensity diminishes, and therefore the relationship between divestitures and a firm's R&D intensity is not longer significant.

Whereas unrelated divestitures, those divested business units that are not related to the firm's core activities, did not appear to be significant in model 8 in table 6, unrelated divestitures present to be significant in model 13 in table 7. This result implies that unrelated divestitures have on a three-year average a positive effect on the firm's R&D intensity. Two possible

explanations for this positive effect may be that financial resources formerly directed to these unrelated businesses units are redirected to R&D activities of firms, or that the funds subtracted from the sale of the unrelated business unit are invested in R&D activities. Either way, unrelated divestitures significantly positively affect the firm's R&D intensity.

Table 7 – Three-year average[5][6]

	Model 11	Model 12	Model 13	Model 14	Model 15
Intercept	3.629 (16.10) ***	3.591 (16.05) ***	3.572 (15.97) ***	3.580 (16.01) ***	3.595 (16.07) ***
Dummy divestitures	0.031 (0.94)				
Divestiture intensity		0.012 (0.72)		0.008 (0.47)	
Related divestures			0.002 (0.14)		
Unrelated divestitures			0.123 (1.96) *		
Leverage x divestiture				0.115 (1.45)	
Diversified scope					0.027 (0.47)
Acquisitions	0.252 (3.89) ***	0.247 (3.79) ***	0.223 (3.36) ***	0.249 (3.82) ***	0.251 (3.89) ***
Liquidity[7]	0.286 (2.69) ***	0.270 (2.53) **	0.278 (2.60) ***	0.274 (2.57) **	0.279 (2.63) ***
Leverage	0.008 (3.15) ***	0.008 (3.17) ***	0.008 (3.17) ***	0.007 (2.76) ***	0.008 (3.14) ***
Firm performance	-0.642 (-15.10) ***	-0.638 (-15.10) ***	-0.635 (-15.00) ***	-0.636 (-15.05) ***	-0.640 (-15.12) ***
Firm size	-0.242 (-9.30) ***	-0.237 (-9.23) ***	-0.234 (-9.15) ***	-0.236 (-9.18) ***	-0.238 (-9.26) ***
Sector R&D intensity	0.046 (1.58)	0.046 (1.58)	0.044 (1.53)	0.046 (1.57)	0.046 (1.59)
Adjusted R^2	0.428	0.424	0.425	0.425	0.423
N	1520	1520	1520	1520	1520

* p < .10 ** p < .05 *** p < .01

Even though the interaction effect of leverage and divestitures is statistically insignificant in models 4, 9 and 14, the positive coefficients for this variable may hint at a positive interaction effect. For the pharmaceutical sector this may indicate that a firm with a poor leverage divests business units in order to undertake R&D activities, instead of using the proceeds from the divested business units to improve its leverage. Furthermore, it may indicate that a poor leverage compels the pharmaceutical firm to divest business units to sustain its R&D activities

[5] All results presented in this table are controlled for autocorrelation.
[6] Appendix C reports the research results when controlling for heteroskedasticity.
[7] The results on liquidity suffered from high levels of heteroskedasticity, therefore no conclusions can be drawn from these results.

as financial institutions are less likely to provide the firm with financial resources. However, one must take into account that this is merely an indication on the relationship between leverage and divestitures, and R&D intensity.

Paralleling the results in the models using a one-year lag, the diversified scope of the firm reports no significant result. Therefore, no conclusions can be drawn for this result. The insignificant result may be due to the sampling frame, since it consists merely of firms active in the pharmaceutical sector resulting in little variation between these firms.

The empirical findings on acquisitions portray an interesting insight into the effect acquisitions have on a firm's R&D intensity for the pharmaceutical sector. In previous studies Hitt et al. (1996) argued that a negative relationship exists between the firm's acquisitions and its R&D intensity. They argued that this negative relationship is the result of a diversion of managerial time and energy from an internal development strategy to acquisitions. In addition to arguments brought forward by Hitt et al. (1996), Burgelman (1986) stated that acquisitions often involve substantial resource commitments resulting in fewer investments in R&D.

A more recent study by Van Beers and Sadowski (2003) argued that due to a lack of a clear technological aim of acquisitions before the 1990s, acquisitions were negatively related to a firm's R&D intensity. However, throughout the 1990s acquisitions focused more on technological issues and the search for new technologies, thereby increasing the firm's knowledge base and resulting in higher levels of R&D intensity for the acquiring firm (Van Beers and Sadowski, 2003). The empirical results reported in table 7 confirm the findings by Van Beers and Sadowski (2003), and thus indicate a positive relationship between acquisitions and the firm's R&D intensity. Another explanation for the positive relationship between acquisitions and R&D intensity may be that pharmaceutical firms tend to acquire those firms closely related to their core activities. Therefore, since R&D expenditures for pharmaceutical firms largely reflect the expenditures on employees, a positive relationship between acquisitions and R&D intensity is likely to exist.

Besides the significant positive effect of acquisitions on the firm's R&D intensity, firm size and performance remain to have a significant negative effect on the firm's R&D intensity compared to the results for the empirical models using a one-year lag. Although Jose et al. (1986) argued that the firm's relative expenditures on R&D activities is to a large extent related to the level of sector R&D intensity, the empirical results reported in this thesis cannot determine the validity

of this argument. No significant relationship for the level of sector R&D intensity has been found for either the models applying a one-year lag or the models applying a three-year average.

To sum up, the empirical results reported in table 7 demonstrate a significant positive effect of unrelated divestitures on the firm's R&D intensity. This result thus statistically implies that unrelated divested business units, those business units that are unrelated to the firm's core activities, have a positive effect on the firm's R&D intensity. Next to the results on divestitures, the findings on acquisitions portray an interesting insight into its effect on the firm's R&D intensity. Based on the empirical results, acquisitions turn out to be positively affecting the firm's R&D intensity.

6.3.4 COMPARISON BETWEEN RESULTS

Hitherto, the empirical findings for the models using a one-year lag and three-year average have been reported. In this final part of the chapter on the research results a comparison between the various outcomes is drawn.

Table 8 reports the expected findings and the realized empirical findings based on the sampling frame used for this thesis. From the results can readily be observed that divestitures, except for unrelated divestitures, have a positive effect on the firm's R&D intensity using a one-year lag. The empirical results based on a one-year lag do support the hypothesis that divestitures have a positive effect on the firm's R&D intensity.

The empirical findings for the models applying a three-year average for all variables in the model show only a significant relationship between unrelated divestitures and a firm's R&D intensity. Possible explanations for this finding may be that financial resources formerly directed to unrelated business are redirected to R&D activities and/or the financial resources obtained through the sale of the unrelated business unit are invested in R&D activities.

The empirical findings for the three-year average on divestitures, divestiture intensity and related divestitures showed no statistically significant results. The fact that in this model all variables have been averaged for a period of three years may have resulted in that the impact of these events on R&D intensity has been diminished.

Table 8 - Expected versus realized[8]

Variable	One-year lag		Three-year average	
	Expected	Realized	Expected	Realized
Divestitures	+	+	+	
Divestiture intensity	+	+	+	
Related divestitures	+	+	+	
Unrelated divestitures	+		+	+
Acquisitions	-		-	+
Leverage	+	+	+	+
Firm performance	+	-	+	-
Firm size	-/+	-	-/+	-

The results on acquisitions for the models using a three-year average demonstrate all a positive effect of acquisitions on R&D intensity. This finding may be counterintuitive, however, as Van Beers and Sadowski (2003) argued, from the 1990s onwards acquisitions focused more on technological issues and the search for new technologies. Therefore, acquisitions can be a facilitator of higher levels of R&D intensity.

Unprecedented are the results on firm performance, since one expects that firm performance would positively affect R&D intensity. The empirical results, however, prove otherwise. The results on firm performance may signal that the necessity to innovate decreases for firms that perform well. Another explanation may be that relative R&D expenditures in the pharmaceutical sector are rigid and are thus not directly affected by a good firm performance.

Leverage and firm size both showed similar outcomes for both models. A firm's leverage enhances its ability to engage in R&D activities. Firm size, on the other hand, has a negative effect on the firm's R&D intensity. This outcome indicates that as a firm grows bigger, its relative expenditures on R&D activities becomes smaller.

[8] Those variables that suffered from autocorrelation and/or heteroskedasticity have been left out of this table.

CHAPTER 7 CONCLUSION

In business practice divestitures are frequently observed, but often treated as side effects of corporate restructuring. However, divestitures, a firm's adjustment and reallocation of its resources through spin-offs, equity carve-outs, split-ups or unit sell-offs, are complex and high impact events. Not merely on the firm level (e.g. performance), but also on the macro level (e.g. industry concentration, size) and the individual level (e.g. motivation), divestitures affect critical parameters.

One of the critical parameters that can be affected by a firm's divestitures is its innovative capacity. Even though the concept of innovation is much debated over by economists, there seems to be agreement that innovation is an important source of economic growth (Narula and Zanfei, 2003). Therefore, based on a sampling frame of 190 firms with some operations in the pharmaceutical sector, this thesis has examined the relationship between divestitures and the innovative capacity of firms, resulting in the following research question:

What effect do divestitures have on the innovative capacity of firms in the pharmaceutical sector?

Before answering the research question, the theoretical framework of this thesis has brought forward several hypotheses. Based upon the empirical results brought forward in this thesis, hypothesis 1 received support; a positive relationship exists between divestitures and a firm's relative R&D intensity.

The effect of a firm's leverage and divestitures on its R&D intensity produced in neither the model applying a one-year lag nor the model applying a three-year average statistically significant results. However, the empirical results do indicate that a positive relationship exists between the interaction effect of leverage and divestitures and R&D intensity. Nevertheless, none of the empirical results are statistically significant, therefore hypothesis 2 is rejected.

Based on the empirical findings brought forward in economic literature, a negative relationship between the diversified scope of the firm and its R&D intensity was expected. For hypothesis 3, however, in none of the models a statistically significant result was found for this variable. For that reason this hypothesis is rejected.

Turning back to the research question of this thesis it can be concluded that divestitures do have a positive effect on the innovative capacity of firms in the pharmaceutical sector. However, the empirical results on divestitures in general, divestiture intensity and related divestitures show a statistically significant positive relationship to R&D intensity using a one-year lag. Averaging all variables for a period of three years indicate no longer statistically significant relationships. Therefore, the empirical results on divestitures in general, divestiture intensity and related divestitures indicate a positive effect only in the short-run. Unrelated divestitures, on the other hand, demonstrate a statistically significant positive relationship on R&D intensity when averaging the variables over a period of three years.

It can thus be concluded that divestitures do have a statistically positive effect on R&D intensity with a one-year lag. Unrelated divestitures have a statistically significant effect on R&D intensity when averaging all variables.

Based upon the effect of divestitures on the firm's R&D intensity found in this thesis, managers and executives need to recognize the importance of divestitures. Divestitures should be regarded as a strategic option that can facilitate the firm in increasing and sustaining its innovative capacity. Therefore, divestitures should not be regarded as the reverse image of an acquisition, but as a strategic option that can create opportunities and value for the firm.

This thesis, however, is subject to several limitations. R&D intensity, the dependent variable of this thesis, was measured as a firm's reported expenditures on R&D activities relative to its sales. Despite that this the most commonly used measure for R&D intensity, it is not a perfect measure of innovation. For instance, small firms are likely to report higher levels of R&D intensity than their bigger counterparts. Nonetheless, the dependent variables measures the intensity of investment in the inputs supporting innovation, and thus not innovation in itself.

Whereas previous studies on the relationship between divestitures and R&D intensity merely observed one geographic region, this study captures firms originating from North America, Europe, and Asia and Pacific. Even though the empirical results portray outcomes on the world level, the model has its limitations. Underlying differences in accounting standards for R&D expenditures between US GAAP and IFRS may have its effect on the reported numbers in the financial reports by each firm in the sampling frame of this study.

In addition, all data, other than the ratios and dummy variables, on the firms within the sampling frame has been converted to US dollars. For possible currency effects, due to fluctuating currencies, has not been controlled in the empirical results presented in this thesis.

This thesis has purely focused on the pharmaceutical sector. Therefore, more research is necessary on other sectors to develop the field of divestitures into a more mature field in economics. Moreover, the effect of the different modes of divestitures can create a new insight into how certain modes affect the firm's R&D intensity. Besides the other sectors and modes of divestitures that can be studied, further research should also address the differences in R&D intensity between American firms and non-American firms to a greater extent and demonstrate how this is related to divestitures.

All in all, based upon the empirical results presented in this thesis, it can be concluded that divestitures have a positive effect on the innovative capacity of firms in the pharmaceutical sector.

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APPENDIX A AMERICAN VERSUS NON-AMERICAN FIRMS

Despite several differences compared to empirical results reported in table 3, overall the results can be judged as robust when controlling for autocorrelation.

Table A - American versus non-American firms

	American vs. non-American
Intercept	3.312 (13.94) ***
Non-American firms	-0.317 (-4.41) ***
Liquidity	0.328 (3.97) ***
Leverage	0.004 (3.10) ***
Firm performance	-0.302 (-8.49) ***
Firm size	-0.204 (-7.45) ***
Adjusted R^2	0.315
N	1900

* p < .10 ** p < .05 *** p < .01

Comparing the above results to the results in table 3, a slight change has evolved for variable non-American firms. The difference between R&D intensity for American and non-American firms has become bigger, indicating that non-American firms' R&D intensity is even lower compared to the American firms. Furthermore, the adjusted R^2 has become lower when controlling for autocorrelation. Overall can be concluded that the results reported in table 3 are robust and therefore representative for the difference in R&D intensity between American and non-American firms.

APPENDIX B – ONE-YEAR LAG: CONTROLLING FOR HETEROSKEDASTICITY

Table B reports the research results when controlling for heteroskedasticity. Contrary to the findings reported in table 6 are the outcomes on the interaction effect leverage x divestiture, acquisitions and liquidity. Whereas for the interaction effect leverage and divestiture no statistically significant relationship was found when controlling for autocorrelation, controlling for heteroskedasticity produces a positive effect of this variable on R&D intensity. Despite this statistically significant result no conclusion can be drawn, since the outcome suffers from autocorrelation. Furthermore, the research results reported in table B demonstrate in all models the insignificant results for both acquisitions and liquidity when controlling for heteroskedasticity.

Table B - Correcting for heteroskedasticity

	Model 6a	Model 7a	Model 8a	Model 9a	Model 10a
Intercept	3.846 (13.55) ***	3.781 (12.56) ***	3.753 (13.24) ***	3.769 (13.29) ***	3.719 (12.75) ***
Dummy divestitures	0.046 (1.83) *				
Divestiture intensity		0.026 (6.21) ***		0.025 (6.65) ***	
Related divestures			0.023 (6.12) ***		
Unrelated divestitures			0.106 (3.91) ***		
Leverage x divestiture				0.144 (2.19) **	
Diversified scope					-0.103 (-1.61)
Acquisitions	0.027 (0.87)	0.026 (0.85)	0.027 (0.86)	0.026 (0.85)	0.024 (0.75)
Liquidity	0.347 (1.00)	0.281 (0.91)	0.278 (0.90)	0.283 (0.91)	0.333 (0.96)
Leverage	0.006 (3.21) ***	0.006 (3.17) ***	0.006 (3.18) ***	0.006 (3.15) ***	0.006 (3.20) ***
Firm performance	-0.620 (-11.90) ***	-0.611 (-11.85) ***	-0.605 (-11.79) ***	-0.608 (-11.81) ***	-0.614 (-11.77) ***
Firm size	-0.279 (-9.16) ***	-0.271 (-8.97) ***	-0.269 (-8.88) ***	-0.270 (-8.92) ***	-0.273 (-9.14) ***
Sector R&D intensity	0.049 (1.81) *	0.051 (1.89) *	0.053 (1.96) **	0.052 (1.93) *	0.048 (1.79) *
Adjusted R^2	0.376	0.373	0.371	0.372	0.373
N	1900	1900	1900	1900	1900

* p < .10 ** p < .05 *** p < .01

APPENDIX C – THREE-YEAR AVERAGE: CONTROLLING FOR HETEROSKEDASTICITY

Below in table C the empirical results are controlled for heteroskedasticity. In the reported results the interaction variable leverage x divestiture does have a significant effect on R&D intensity. Nevertheless, no conclusions can be drawn from this result, since it suffers from autocorrelation. Despite changes in the levels of significance for leverage and divestiture, liquidity and sector R&D intensity, overall the results portray a similar view as the results reported in table 7. For instance, the research results on the dummy divestitures, divestiture intensity and related divestitures remain statistically insignificant.

Table C - Correcting for heteroskedasticity

	Model 11a	Model 12a	Model 13a	Model 14a	Model 15a
Intercept	3.949 (13.73) ***	3.837 (13.96) ***	3.721 (13.61) ***	3.782 (13.82) ***	3.855 (13.93) ***
Dummy divestitures	0.095 (2.42) **				
Divestiture intensity		0.052 (1.26)		0.032 (1.24)	
Related divestures			-0.008 (-0.39)		
Unrelated divestitures			0.637 (3.90) ***		
Leverage x divestiture				0.521 (2.77) ***	
Diversified scope					-0.070 (-0.93)
Acquisitions	0.495 (5.07) ***	0.476 (4.93) ***	0.407 (3.31) ***	0.488 (5.09) ***	0.491 (5.12) ***
Liquidity	0.058 (0.17)	0.000 (0.00)	0.036 (0.10)	0.018 (0.05)	0.049 (0.14)
Leverage	0.008 (2.22) **	0.008 (2.25) **	0.008 (2.27) **	0.002 (0.28)	0.008 (2.28) **
Firm performance	-0.845 (-14.79) ***	-0.835 (-14.85) ***	-0.801 (-14.68) ***	-0.820 (-14.87) ***	-0.836 (-14.37) ***
Firm size	-0.272 (-8.81) ***	-0.257 (-8.87) ***	-0.245 (-8.53) ***	-0.252 (-8.73) ***	-0.257 (-8.85) ***
Sector R&D intensity	0.123 (3.39) ***	0.128 (3.53) ***	0.117 (3.26) ***	0.127 (3.50) ***	0.124 (3.38) ***
Adjusted R^2	0.453	0.443	0.441	0.446	0.445
N	1520	1520	1520	1520	1520

* p < .10 ** p < .05 *** p < .01