The influence of acquisitions on the productivity growth of Dutch companies

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Executive Summary

Despite the fact that the number of acquisitions and their value stay continuously high, there is no consensus, whether or not acquisitions positively influence the performance of companies. This study's main goal is therefore to add to the current discussion on acquisitions and performance. This study introduces several new features. The first is that companies in Dutch manufacturing are the object of research. It has not been since the 1980s that the influence of acquisitions on the performance of Dutch companies is studied. The second new feature is the fact that the influence of acquisitions on the productivity growth of companies is studied. In most studies the influence of acquisitions is related to profitability, market share, or innovative performance. The last feature is that it uses a new methodology to measure the acquisition activity of companies. This new methodology is the DYNAMO-Program that has been developed at Statistics Netherlands.

When the theoretical background is analyzed, it becomes clear that the influence of acquisitions on the performance of companies differs per country and study. For instance, for the U.S. (Ravenscraft & Scherer, 1987) and the U.K. (Hughes, 1989) a negative relation between acquisitions and the profitability of firms is found. In contrast, similar studies for Japan (Ikeda & Doi, 1983) and Canada (Baldwin, 1995) have found a positive relation between acquisitions and profitability.

The conceptual model that is used in this study links the dependent variable productivity growth for the period t-2 to t, to the independent variables capital, size, innovation intensity, lagged productivity, and finally the acquisition activity. The acquisition variables measure the acquisition activity at t-1 and t. All variables are collected at the highest level of aggregation at which Statistics Netherlands collects economic data: the company or ultimate beneficial owner (UBO). To estimate the conceptual model three datasets are created that can study the productivity growth over an individual period. The first period is 1996-1998, the second 1998-2000, and the third 2000-2002. The three datasets are created by merging files from the following Statistics Netherlands data sources: DYNAMO, financial statistics for companies (SFO), and the Community Innovation Survey (CIS). The descriptive statistics of the three datasets show a consistent picture; the characteristics of the three datasets are more or less the same. The most striking feature is that despite the fact that acquiring companies have higher innovation expenditures than non-acquiring companies; the innovation intensity of acquiring companies is lower. This could indicate that acquisitions are a substitute for innovation.

The statistical model is estimated four times per period. First a restricted model is estimated, without any acquisition variable, then three models are estimated in which the acquisition variables are measured separately and together. The results indicate that the created model is stable as the sing and degree of significance of the coefficients are consistent within the three periods and between the first and the last period. Furthermore, the R^2 of the models improve when the acquisition variables are added. This is a first indication that a relation between acquisitions and productivity growth exist. Other important results are that the amount of capital per employed person positively influences the productivity growth of companies, the companies in the three datasets experience increasing returns to scale, innovation intensity positively influences the productivity growth of companies, and the lagged productivity influences the productivity growth negatively. The most important results, however are that the acquisition activity at t-1 has a negative influence on the productivity growth of companies and that the acquisition activity at t has a positive influence on the productivity growth of companies. This could indicate that acquiring companies experience very short term positive effects, but that these effects are leveled out and even become negative later on.

Concluding, this research has found that the influence of acquisitions on productivity growth of companies differs over time. On the very short term acquisition influence the productivity growth of companies positively, but on the longer term this effect becomes negative. Further research should be done to find out what underlying factors cause these differences.

Preface

The second of June, 2006 was the first day of my internship at Statistics Netherlands for my master thesis. Today, almost one and a half year later, I am at the verge of finishing this project. When I look back at the previous period, I must say that I did not expect the process of writing a master thesis to be so hard. When writing a master thesis alone, there is no one to blame for the fact that the process is not going as fast as you should like. However, despite the difficulties, it has been one of the most rewarding projects in my career as a student.

There are several persons that I would like to thank for their support. First, I would like to thank Bert Diederen for the fact that he took the time to get me acquainted with all the specific aspects that were relevant for this study and the fact that he gave me the opportunity to develop my own perspective and approach to solve the problems that we came across with the DYNAMO-Program. Furthermore, I would like to thank Bert Sadowski for the advice and guidance he gave me during the past period. He helped me to get to the point where I am today. I would also like to thank Bart Verspagen, whose critical comments helped to improve the quality of my thesis. Moreover, I want to thank all the students in the K-gang for the lunches, coffee breaks, and Friday poker session. In addition, I would like to use this place to thank my parents for the help, support, and good advice on so many different aspects, which they have provided me during the almost eight years that I was a student. Finally, I would like to thank Fieke, who has been my anchor during the seven years that we know each other. Thanks, for the fact that you helped me get over the times in which I was demoralized. Without you, I would still be writing and be nowhere near finishing my thesis.

Jurjen Ophuis
Eindhoven, December 2007

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1. Introduction

During the last decade the average number of mergers and acquisitions (M&A)[1] deals in the U.S. was around 10,000 per year with an average total value of around 1,000 billion dollars. The 11,750 deals that were made during 2006 showed the highest value in over sixty years with a total of 1,484 billion dollar.[2] These figures indicate that the market for corporate control is currently at the highest point ever and that we are currently at the top of one of many M&A waves that have occurred since the beginning of the previous century. Despite the fact that last year's value of acquisitions in the U.S. was the largest ever, there is still no consensus on whether or not acquisitions positively influence the performance of the newly formed company. With a failure rate of around fifty percent it is obvious that not every M&A is a success. However, the magnitude of the figures above indicates that managers still believe in the positive outcomes of M&A. Despite the fact that, in general, mergers represent the creation of a new company by two equals and acquisitions refer to the takeover of one company by another; they will be used interchangeable in this study, as they both are related to corporate control.

When the discussion on M&A and its influence on business processes is analyzed it becomes clear that many studies have found different results. For instance, for the U.S. (Ravenscraft & Scherer, 1987) and the U.K. (Hughes, 1989) the results show that acquisitions have a negative influence on the profitability of companies. In contrast, similar studies for Japan (Ikeda & Doi, 1983) and Canada (Baldwin, 1995) show a positive influence. Most of the input of the discussion is based on small scale studies that use data panels from the 1960s, 1970s, or 1980s. There have been only few studies that have used recent, large scale data sets. Most of the studies that are referred to above study the influence of acquisitions on the profitability, the market share, or the innovative performance of the firms. An aspect that has received little attention in the discussion is the influence of acquisitions on the productivity growth of companies.

When the discussion is applied for at the Dutch economy it turns out that there have not been many scholars that studied the success of M&A at company level. The acquisition activity in the Netherlands in the 1960's and its influence on several business processes has been studied by Peer (1980) and more recently the influence of acquisitions on a Dutch firm's propensity to innovate has been studied by Van Beers and Sadowski (2003). One of the most important reasons that the influence of acquisitions on business processes of Dutch firms has not been studied in detail until now is the lack of the availability of relevant datasets. However, during my internship at Statistics Netherlands last year Bert Diederen and I developed the DYNAMO-Program. The DYNAMO-Program is a combination of a set of longitudinal files that describe the structure of Dutch companies and a syntax that can extract the changes (**DYNAM**ics) in the structure of the companies (**O**ndernemingen) from these files. The changes in the structure of companies comprise among others the creation, destruction, acquisition, and divestment of parts of firms. With the DYNAMO-Program it becomes possible to do large scale longitudinal analysis of the different aspects of dynamics of the companies that are active in the Dutch economy.

As is stated above an important aspect of firm dynamics is the influence of acquisition activity on the performance of firms. With the use of the DYNAMO-Program it becomes possible to make a contribution to the discussion on the influence of acquisition on the performance of companies. The outcomes are interesting as it has not been since the 1980's (Peer, 1980) that the influence of acquisitions on the performance of Dutch companies has been studied. So this study's main objective is to shed light on the influence of acquisitions on the performance of Dutch companies and specifically on the

[1] The generic term mergers refers to the creation of a new company by the fusion of two or more (equal) companies, the term acquisitions refers to a takeover, where the control of one company or a part of a company shifts from the one company to the other. Although these terms have different meanings the literature on the topic uses them interchangeable; so does this study.
[2] www.mergerstat.com; checked November, 2007.

productivity growth of these companies. This leads to the following main research question that is answered in this report:

What is the influence of acquisitions on the productivity growth of companies in Dutch manufacturing?

In order to answer this main question first the research framework is described to get a clear description of some specific aspects of this study and their definitions. This refers to definitions of mergers and acquisitions, and of the problems that come with the different levels of identification that are used by Statistics Netherlands.

Next, the theoretical background of the discussion on acquisitions and their influence on the different business processes is provided. This includes the outcomes of previously published studies, the most important motives for firms to get involved in M&A, and finally the different reasons for success or failure of M&A.

After the theoretical background is described the used methodology and data are explained in detail. This chapter provides a description of the conceptual model that is used to study the influence of acquisitions on the productivity growth of companies in the Dutch manufacturing. Furthermore, it provides a detailed description of the data sources that are used to perform the analysis; this also includes a short description of the creation of the DYNAMO-Program. As the DYNAMO-Program only provides the acquisition variables, other sources from Statistics Netherlands are needed for additional information on the companies. This chapter does not only provide a description of these data sources, but also a detailed account of the process of the aggregation and merger of these files. In addition the selection of the companies that are relevant for this study is described. Finally, this chapter presents the most important descriptive statistics of the companies that are relevant for this study and shows some differences between companies that have made an acquisition and those that have not.

Next, the results of the study are displayed combined with a detailed description, also and the some explanations for these results are given using the theoretical background that is described in the earlier chapter.

Finally, the most important conclusions that can be drawn from this report are presented along with a discussion on the results and some recommendations for further research.

2. Research Framework

2.1 Introduction

In order to understand the value of this research it is necessary that its framework is known. The research framework provides the definitions of the terminology that is used in this research. It can be split into two parts; the first part is concerned with the terminology that is used with respect to mergers and acquisitions. The second part provides information on the relation between the different statistical units of measurement. The unit of measurement that is used in this research determines the comparability with other studies that have used other data sources.

2.2 Mergers and acquisitions

In the process of merger and acquisition there are three main parties involved; the target firm, the bidding firm, and finally the acquiring firm. Nowadays, with the high priority to anti-trust regulations there are also a large number of controlling parties, like the European Anti Trust Commission. The firm that is object of the acquisition effort is called the target firm, firms that are interested in acquiring the target firm and make an offer to acquire it are called the bidding firms, and the firm that acquires the target firm is called the acquiring firm. Three forms of legal procedures are often used in takeovers: merger or consolidation, acquisition of stock, and acquisition of assets (Baldwin, 1997). A merger refers to a combination of two or more firms in which the bidding firm offers to absorb the assets and liabilities of the target firm. The bidding firm usually retains its name while the target firm usually ceases to exist after a formal merger. A consolidation is the same as merger, except that both bidding and target firms combine to create a new entity. With the acquisition of stock, the bidding firm simply offers to purchase the target firm's voting stock. The purchase may take the form of a cash payout, offer of shares in stock of the bidding firm, a combination of both, or offers of other securities. The acquisition of assets involves the bidding firm simply offering to buy all or most of the assets of the target firm. The target firm, however, does not necessarily cease to exist (Adelaja, 1999). In this study the term acquisition will be used to refer to the gaining of the control over the target firm by the acquiring firm by any means.

There are several categories of mergers and acquisitions that can be identified; the Federal Trade Commission (FTC) has created five different categories:

- Vertical merger: a firms acquires former suppliers or customers;
- Horizontal merger: a firm acquires a former competitor;
- Product extension merger: a firm gain access to complementary products though an acquisition;
- Market extension merger: a firm gains access to complementary markets through an acquisition;
- Conglomerate merger: there is no strategic relatedness between bidding and target firm (Barney, 1997).

Any kind of merger or acquisition can be classified into one of these five categories. For policy makers the identification of a merger or acquisition is highly important, since different mergers and acquisitions have a different influence on competition. For instance, horizontal M&As are more likely to create monopoly power than conglomerate mergers. This research will not make a distinction between the different types of mergers, as the sector classifications are not taken into account. This research defines a merger or acquisition as the takeover of a (part of) a firm by another firm.

2.3 Business units and companies

In social statistics the most unique identifier is a person. This is an identifier that is universally used and easily understood by everybody, since every person is unique. However, in economic statistics there is not a unique identifier that is universally used. There is no consensus on what the most unique identifier for economic statistics is. The

choice of which most unique identifier is used depends on the agency that collects the data and the country in which it is collected. For instance, the Dutch Chamber of Commerce uses corporate persons as identifier to collect data on companies, the Dutch tax authorities use the VAT number of companies (Diederen, 2000) to collect taxes and data. Between the statistical agencies there are also differences; in Canada, Statistics Canada uses a dual level identifier. This means that the most unique level of identification is plant[3] level; the second most unique level is company level. In Europe, statistical agencies, which includes Statistics Netherlands, use three different levels: legal units (*in Dutch:* juridische eenheid), enterprises (*in Dutch:* bedrijf or bedrijfseenheid), and companies (*in Dutch:* onderneming).

The first level, the legal unit is a corporate or natural body.[4] This unit is not relevant for this study as Statistics Netherlands does not collect any relevant economic data at this level.

The second level at which economic data is collected is the enterprise level. Statistics Netherlands uses a different definition of enterprise than the definition that Eurostat uses. The definition of enterprise by Eurostat is based on the European Union Council Regulation (EEC) No 696/93 of 15 March 1993 and is: "the enterprise is the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations. An enterprise may be a sole legal unit."[5] It is important to realize that the identifier enterprise does not correspond to the identifier company. A company can consist of one enterprise, but also of several groups of organizational units that are autonomous in their decision making, also known as enterprises. So an enterprise can be a company, but a company does not necessarily need to be an enterprise. This problem is explained in detail below.

Statistics Netherlands uses the kind-of-activity unit definition by Eurostat as a basis for the determination of the statistical unit bedrijf, which is translated as enterprise.[6] The definition of the kind-of-activity unit in EEC No 696/93 is the following: "The kind-of-activity unit (KAU) groups all the parts of an enterprise contributing to the performance of an activity at class level (4-digits) of NACE Rev. 1 and corresponds to one or more operational subdivisions of the enterprise." In this definition the main aspect is that a KAU consists of parts of the enterprise that are all active in the same economic sector. The KAU is a lower level of aggregation than the enterprise. In order to set a boundary for the attempts to determine the separation between kind-of-activity units homogeneously, Statistics Netherlands has added extra aspects to the definition of bedrijf. These aspects concern that a bedrijf has autonomy in the production process and a shows focus towards third parties. The final definition of bedrijf therefore consists of two parts. The first part focuses on the kind-of-activity unit and the second focuses on the autonomy in the production process and a focus towards third parties. These two parts are contradicting in their nature. In order to overcome any problems, the focus lies on the second part of the definition. As the term bedrijf shares communalities with the other Dutch term onderneming the term bedrijfseenheid is used instead of bedrijf. Bedrijfseenheid is abbreviated as BE. Statistics Netherlands translates bedrijfseenheid as enterprise, despite the fact that the definition does not correspond with the definition of Eurostat. In addition, the term enterprise often is used interchangeable with the term company or firm. For that reason, instead of the enterprise this research introduces the new term business unit as a translation of bedrijfseenheid.

The third level of the collection of economical data is the company level. The company level refers to the level that has the control over one or more business units. Within

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[3] With this identification, the actual location of the plant is used as the selection criteria. However, problems can arise if two part of a company are not situated in the same location, but are very much intertwined in their operational management. The identification at plant level will identify two different plants despite the fact that they operate as one. Other problems that can occur with this method of identification is the fact that the movement of a firm from one location to another will be characterized with a discontinuity in the longitudinal development of a company; it will look like if the firm has closedown a plant and opened a new one, and will overestimate the dynamics in firms.

[4] www.cbs.nl, Home, Methoden, Begrippen, Juridische Eenheid, checked November, 2007.

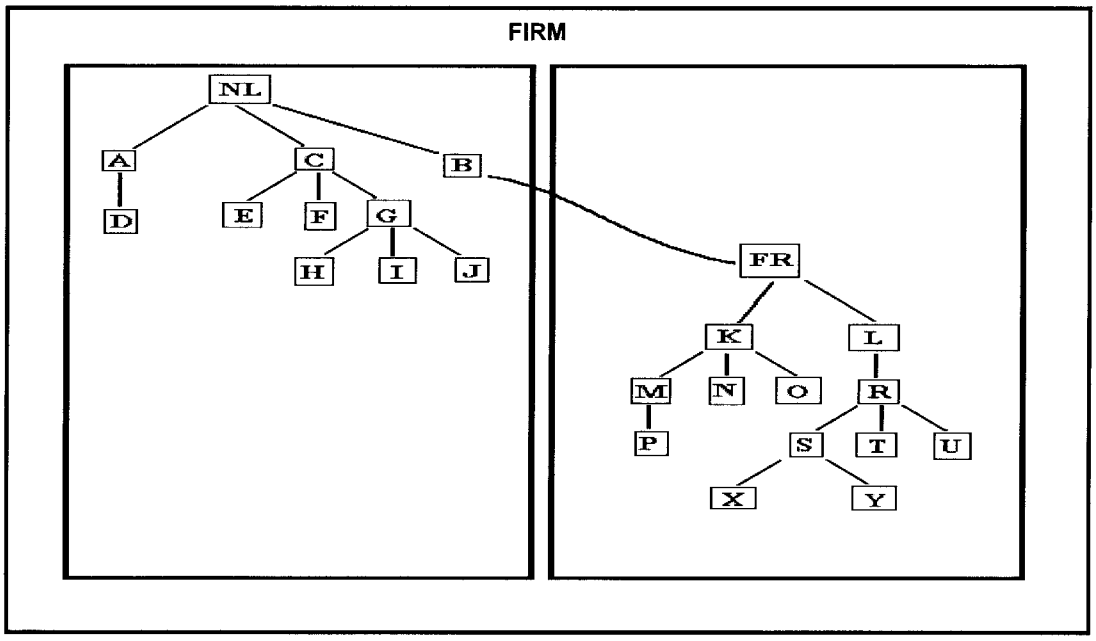
[5] European Union, Council Regulation (EEC) No 696/93 of 15 March 1993. The statistical units for the observation and analysis of the production system in the Community. (Official Journal of the European Communities No L 076, 30/03/1993, p. 1), Section III A.

[6] www.cbs.nl, Home, Methoden, Begrippen, Bedrijf, checked November, 2007.

Statistics Netherlands, there are two definitions concerning the term company. The first one refers to the enterprise group principle used by Eurostat. An enterprise group is the collection of enterprises that are all linked together either through legal or financial links. An enterprise group can have more than one decision-making centre, especially for policy on production, sales and profit. It may centralize certain aspects of financial management and taxation. It constitutes an economic entity which is empowered to make choices, particularly concerning the units which it comprises.[7] The economic data that is compiled at this level is the aggregation of the data that is available for the entire enterprise group. The other definition of company level refers to the ultimate beneficial owner principal. The ultimate beneficial owner (UBO) of a given unit is the unit which, while going up the chain of direct and indirect majority owners, is not owned by more than fifty percent by another unit.[8] This means that the UBO has control over the business units it owns. This level at which economic data is collected is called a group or cluster of enterprises. The data that is collected at the group of enterprises level corresponds to the consolidated domestic account of a cluster of related enterprises (Diederen & Ophuis, 2007). The yearly figures are based on annual accounts of companies. This is in contrast to the figures on enterprise groups which are created through aggregation. Statistics Netherlands translates the term group of enterprises as onderneming, which is abbreviated as OND. The results for the enterprise group do not necessarily correspond to the results at the group of enterprises level. This discrepancy is caused by the fact that at the enterprise group, the results for the individual business units are aggregated. The economic data, e.g. turnover, value added, that is collected for business unit is likely to be influenced by internal deliveries or other aspects that need to be taken into account at business unit level but are leveled out at the consolidated accounts. It is important to realize that business units are statistical constructs that may not actually exist as separate legal or fiscal entities. In this research, the term company or firm refers to the group of enterprises, when the term enterprise group is meant it is explicitly mentioned.

In extend to the above; it is necessary to realize that Statistics Netherlands only collects data on business units that are active in the Dutch economy. For the multinational companies this means that only the activities in the Dutch economy are measured.

Figure 1: Enterprise clusters – the relation between BEs and ONDs



[7] European Union, Council Regulation (EEC) No 696/93 of 15 March 1993. The statistical units for the observation and analysis of the production system in the Community. (Official Journal of the European Communities No L 076, 30/03/1993, p. 1), Section III C, of 15.03.1993 on the statistical units for the observation and analysis of the production system in the Community.

[8] http://ec.europa.eu/eurostat, Home, Concepts/Definitions, Ultimate Beneficial Owner, checked November, 2007.

In Figure 1 an example of the relation between enterprise clusters, BEs and ONDs is given. The figure represents the structure of an enterprise cluster from a multinational company FIRM with the Dutch nationality and economic activities in the Netherlands and France. The largest rectangle represents the company, the left rectangle containing the business units NL, A, B,..., I, J, represents the BEs that are active in the Dutch economy, and the right rectangle the business units, FR, K, L,..., U, X, Y, that are active in the French economy. The ABR only registers the business units that are active in the Dutch economy; so it will only measure the left rectangle. The complicated relation as it exist between the separate BEs in this figure is reduced in the ABR by the fact that the only relation that can be found is that the company FIRM is the owner of BEs NL, A, B,..., I, J; other hierarchies are not measured.

2.4 Conclusion Research Framework

This chapter has provided a framework for this research. The three parties that are involved in a merger or acquisition are the target firm, bidding firm, and acquiring firm. There are five categories in which a merger or acquisition can be classified; however they are not taken into account in this research. The used statistical identifiers are business unit and company. Although Statistics Netherlands translated the term bedrijf as enterprise, their definition does not correspond to the definition that is used by Eurostat. This difference in definition, along with the fact that the term enterprise can be confused with company is the term business unit is introduced. At company level there are two methods of data collection. The first one is enterprise group, which is the aggregation of all the business units that are part of the company and the second one is the group of enterprise level, which is the total of the consolidated domestic account. This study refers to the group of enterprise level when the term company is used.

3. Theoretical Background

3.1 Introduction

The 20th century saw several great merger waves, the most recent waves were at the end of the 1960s, 1980s, 1990s (e.g. Gugler et al., 2003), and at the beginning of the 21st century. To give an indication of the size and importance of M&A activity in the U.S.: in the first three quarters of 1994 there were already 5.800 mergers and acquisitions involving at least one company that had a headquarter in the U.S.. The total economic value of mergers and acquisitions in 1994 in the U.S. was $344 billion (Barney, 1997). While much of the earlier merger activity was confined to North America and Great Britain, the most recent wave during the 1990s took place at all of the major industrial countries of the world (Gugler et al., 2003). Not only the geographical location, but also the motives for M&A in the 1990s wave differ from the earlier merger waves. In the 1960s, a typical merger motive was conglomerate building; in the 1980s bidders focused on short-term ways of squeezing cash out of the target companies to pay off bank debt and junk bonds that were used in the acquisition, and during the 1990s the most important motives for M&A wave were gaining access to new markets and increasing the innovation potential of firms (Sorensen, 2000; De Man and Duysters, 2006; DePamphilis, 2005).

It is clear that M&A still remains a very popular company restructuring activity; despite the fact that only half of all mergers are a success. The implementation of a merger or an acquisition can influence almost every aspect of the operational management of a company. Despite the numerous studies that have been done, no consensus on the precise influence of M&A on the different aspects of operational management has been reached. This chapter describes first the discussion on the relation between acquisitions and performance. Second, it provides a short overview of the theories on M&A. Finally, it deals with the reasons for the success or failure of M&A.

3.2 Literature review

When the discussion on acquisitions is reviewed it becomes clear that there are several possibilities to study the influence of acquisitions on the business processes. The field of study that has the most parallels with this study is the field that studies the influence of acquisitions on the performance of companies. Therefore this field receives the most attention in this literature review. There are many ways in which the performance of companies can be measured. It can be measured through, for instance, the profitability, productivity, growth rate, or the innovative output of firms. The first three are firstly dealt with, the innovation performance of firms secondly.

3.2.1 Acquisitions and profitability, productivity, and growth rate

The first group of scholars that have studied the influence of acquisitions on the performance of companies have compared the actual post-merger profits with those predicted using a control group. The results of around twenty studies drawn from around ten countries are summarized in a survey of literature done by Mueller (1997). It becomes clear that results differ from country to country. Ravenscraft and Scherer (1987) have studied U.S. data and found that profitability of acquired firms declined after they were acquired. In comparison, Healy (1992) has found a significant increase in the pre-tax cash flows of the companies that were involved in the fifty largest mergers in the U.S. between 1979 and 1984. This implies that the mergers increased the market power or the efficiency of the firms that were involved in the mergers. For the U.K., the majority of the studies have found that acquisitions reduce profitability (Hughes, 1989), whereas some have reached the opposite conclusion (Cosh et al., 1980). For other countries the results are more contradictory, some have found a positive influence: e.g. for Canada (Baldwin, 1995) and Japan (Ikeda & Doi, 1983), whereas others have found a negative influence: e.g. for the Netherlands (Peer, 1980), and Sweden (Ryden & Edberg, 1980).

When the literature on the growth rates of firms is reviewed it becomes clear that again there are differences between countries, but that the growth rate is either non-significantly or negatively influenced. For the following countries no significant influence has been found: e.g. Belgium (Kemps & Wtterwulghe, 1980), France (Jenny & Weber, 1980), Germany (Cable et al., 1980), and Sweden (Ryden & Edberg, 1980). For the following countries there significant negative influence of acquisition on the growth rates are found: e.g. the Netherlands (Peer, 1980), and the U.S. (Mueller, 1980). In these studies the influence of acquisitions on the growth rate is measured by making an estimation on what the growth rate of the firm would have been without the acquisition.

Capron (1999) has found a positive relation between acquisitions and the performance of European and U.S. firms using a subjective measurement of performance; namely interviewing the managers that were involved in the acquisition. Sorensen (2000) has compared the profitability of acquiring firms with non-acquiring firms and has found that acquiring firms are more profitable than non-acquiring. An extensive study by Conn (2005) into the difference between different kinds of acquisitions has found that acquisitions in the U.K. yield negative or non-significant announcement returns.

None of the previously mentioned studies have used productivity growth as an estimator for performance. This is interesting as the majority of acquisitions will be done to improve the overall productivity of the acquiring company. Despite the quality of the methodologies of the above mentioned studies almost all have the disadvantage that they do not have access to a large sample. The majority of the studies create their samples from analyzing the press for announcements of mergers or acquisitions. The samples that are created via this method are bound to be restricted by several factors: the process of data creation prohibits the construction of large multi-sector data sets. Therefore the results are not as if a large scale data set was used.

3.2.2 Acquisitions and innovation

Besides the vast amount of literature that is available on the influence of acquisitions on the performance of companies there is also a growing field of study that researches the influence of acquisitions on the innovative performance of companies. This field has emerged during recent years due to the fact that innovation is becoming an important motive for acquisitions. Whether these acquisitions positively influence the innovative performance of the companies remains the question. Within the literature on acquisitions and the innovative performance of firms there are two streams of literature that have developed rather independently from each other (Ahuja & Katila, 2001). The first area of scholars has a corporate control background; the second comes from innovation studies. Both streams are dealt with in this chapter; first the results of the corporate control tradition are provided, secondly the empirical results of the innovation scholars.

The corporate control tradition has found that acquisitions negatively influence the innovative performance of firms. Hitt et al. (1991) have studied U.S. companies and have found strong evidence for a negative relation between acquisitions and the R&D investments and R&D output of firms. This result has also been confirmed by the Hitt et al. (1996), who have found that firms actively buying other businesses are less likely to produce internal innovation. These two studies have not made any distinctions between the motives for the acquisition; this is an important aspect of the analysis of acquisitions as some acquisitions are not undertaken to improve the innovative performance of firms. If an acquisition is undertaken from a strategic point of view or to increase the market power of the acquiring firm it is not likely that the innovative performance will be positively influenced by the acquisition. Hitt et al. (1998) surveyed the perception of managers on the post-acquisition performance to analyze the influence of acquisitions and have found some positive and some negative cases.

In contrast to scholars studying the market for corporate control, the innovation literature has found a positive relation between acquisitions and the innovative performance of companies. Several innovation scholars have made a clear distinction between technology motivated acquisition and non-technological acquisitions. Ahuja and Katila (2001) have studied the global chemical industry and have found a non-significant relation between non-technological acquisitions and the subsequent innovation output of the acquiring firm, and a positive relation between technological acquisitions and the innovation output. These results are confirmed by Cloodt et al. (2006). These two studies have made a clear

distinction in the motive of the acquisition. This distinction results in another outcome than the non-differentiated approach of the scholars with the corporate control background. Van Beers and Sadowski (2003) have also found a stable and significant positive correlation between acquisition activity and their probability to produce innovations in the Dutch manufacturing and services sector.

3.3 Theoretical approaches to M&A

There are numerous reasons why companies want to get involved in M&A. When the different motives for M&A are analyzed, it becomes clear that most scholars agree that mergers are driven by a complex pattern of motives, and that no single approach can render a full account (Ravenscraft & Scherer, 1987). The different motives for M&A can be categorized into several theories. Trautwein (1990) has classified different M&A theories; the most important ones are the following five theories: valuation theory, monopoly theory, efficiency theory, empire building theory, and process theory. In recent years M&A has been done more and more to improve the innovative performance of companies (Sorensen, 2000). Innovation as a motive for M&A can be classified as part of the process theory. The motive for an acquisition determines the success or failure of the acquisition and therefore it is an important aspect of the acquisition process. This paragraph describes shortly the five theories that are mentioned above and combines the theories from Trautwein (1990) with recent findings.

3.3.1 Valuation theory

Companies will only get involved in M&A if the parties that make the M&A decision for the company think that the newly created company generates more benefits in any possible way, than the separate entities before the merger or acquisition. The theory is that mergers are planned by managers who have better information about the target's value that the stock market (Ravenscraft & Scherer, 1987). Bidders' managers may have unique information on possible advantage to be derived for combing the target's business with their own (Trautwein, 1990). Barney (1997) has created the following equation to explain this. He states that if the following equation holds it is likely that a firm will make a bid for a target firm:

$$NPV(A+B) \geq NPV(A) + NPV(B)$$

Where,

NPV(A) = net present value of Firm A as a stand-alone entity
NPV(B) = net present value of Firm B as a stand-alone entity
NPV(A+B) = net present value of Firms A and B as a combined entity

If this equation holds the combined entity of the two firms will make either normal economic profits or will create above-normal profits. In the case of an unrelated merger or acquisition (classified by the FTC as a conglomerate merger) it is likely that both sides of the equation will be equal to each other; this because there are no expected synergies, this will be explained below (Barney, 1997). A reason for such a merger or acquisition can be a diversification strategy to minimize risks of focusing too much on one market. If a firm is active in a declining industry; it can diversify by acquiring companies in other rising markets. Although research has shown that this is not a good strategy in every industry, it is a necessity in industries that are on the verge of extinction (Anand and Singh, 1997). Other motives for such a M&A is conglomerate building.

In the case of a related merger it is likely that the net present value of the combined entity of firm A and B is larger than the net present value of firm A and B as stand-alone entities. This difference is caused by the fact that if related firms merge they can increase the value of the combined entity by cost savings or revenue enhancements (Barney, 1997), so they have more value as a combined entity than as separate entities, which do not benefit from the synergies.

The equation describes the basic economic theory that states it is likely that if the net present value of the through M&A newly formed entity is equal or higher that the net present value of the separate entities bidding firms will actually make a bid for the target firm. This theory seems to hold for every M&A. However this theory does not describe the different ways in which the higher or equal net present value can be realized. This will be

done below, where the most important motives for acquiring firms to get involved in acquisition will be given; these motives are: market power, synergies, diversification, management, and innovation and technology. For each motive below there is a way to realize a higher or equal net present value for the newly created entity.

3.3.2 Monopoly theory

This theory views mergers as being planned and executed to achieve market power (Trautwein, 1990). The theory of market power suggests that firms merge to improve their monopoly power to set product prices at levels not sustainable in a more competitive market (DePamphilis, 2006). There are several possibilities in which a merger or acquisition can influence the market power of a firm. A horizontal acquisition can give the acquiring firm enough market power to enhance its bargaining position with suppliers, or in a small market even monopoly powers (Vermeulen and Barkema, 2001). A company can also make a conglomerate building acquisition or diversifying acquisition. A diversifying acquisition refers to the strategy of a firm to become active outside a company's current primary line of business. Via diversification it becomes possible for firms to cross-subsidize products. Profits from the position in one market are used to sustain a fight in another (Trautwein, 1990).

3.3.3 Efficiency theory

The efficiency theory argues that mergers are planned and executed to achieve synergies (Trautwein, 1990). Synergies can occur if the combination of two businesses can create greater value than if they operate separately (DePamphilis, 2005). Some empirical studies have suggested that anticipated synergies are important determinants of shareholder wealth creation (Houston et al., 2001). Two types of synergies can be identified: operating synergies and financial synergies.

Operating synergies (economies of scale and scope)

The first types of anticipated synergies are operating synergies, which in their turn can be divided in economies of scale and economies of scope. Economies of scale are said to be present in production when unit (average) cost decrease as the volume of output increases. There are a number of explanations for the presence of economies of scale: the existence of substantial fixed costs, opportunities for specialization in the deployment of resources, and a strong market power position vis-à-vis supplier of factor inputs (Given, 1996; DePamphilis, 2005; Trautwin, 1990). Economies of scope are analogous to economies of scale but imply efficiency gains resulting from expansion of scope rather than from an increase in the volume of total output. It is the advantage a firm with a diversified production holds above separate firm, each specializing in a single type of output (Given, 1996; DePamphilis, 2005).

Financial synergies

The second types of anticipated synergies are financial synergies. Such synergy refers to a decrease of the cost of capital of the acquiring firm or the newly formed firm through a merger or acquisition. The cost of capital can be reduced if two firms realize financial economies of scale by lowering securities and transaction costs, or result in a better matching of investment opportunities with internally generated funds. Another option is the merger of a firm with excessive cash flows with one that has a low internally generated cash flow; the combination of these two can result in lower costs of borrowing for the firm that has a low cash flow (DePamphilis, 2005; Trautwein, 1990).

3.3.4 Empire building theory

According to this theory mergers and acquisition are planned and executed by managers who thereby maximize their own utility instead of their shareholders' value. There are two clear examples: management compensation and managerial hubris.

Management compensation

Another motive for M&A can be found in management compensation. M&A can benefit managers directly; independent of any value they may or may not create for a bidding firm's stockholders. If management compensation is closely linked to firm size, managers

who increase firm size are able to increase their compensation. Of all ways to increase the size of a firm, M&A is perhaps the easiest (Barney, 1997).

Managerial hubris

The target firm's stockholders often gain significant value from an acquisition. Acquiring firms may replace inefficient managers, thereby improving the value of targets firms' output following acquisition (Hitt et al, 1991). However, sometimes managers hold the unrealistic believe that they can manage the assets of a target firm more efficiently than the target firm's current management, this unrealistic believe is called managerial hubris (Barney, 1997). Another example of hubris is when managers believe that their valuation of the target firm is superior to the market's valuation of the target firm. This overestimation will cause the bidding firm to make an offer that is higher than the actual value of the firm. Since the firm is not worth the price that is paid for, the acquiring firm will have to recover the extra costs that were made to purchase the firm in another way (DePamphilis, 2005).

3.3.5 Process theory

The process theory is based on the strategic decision process. The decision of firms to acquire another company to improve their innovative performance is a strategic decision. Therefore it can be stated that process theory can relate to innovation. The relation between process theory and innovation is relatively new, as innovation only recently has become and important motive for M&A. During the merger wave of the 1990s it is reckoned as one of the most important motive. The growing importance of innovation can be explained by the fact that innovation is one of the leading determinants of economic growth and an important predictor of corporate growth (Franko, 1989). Innovation as a motive for M&A can be split up into three general categories: innovative synergies, resource deployment, and corporate control.

Innovative synergies

Mergers and acquisitions are found to be increasingly used to absorb complementary external technological capabilities, or new knowledge and resources needed to compete successfully in radically changing economies (De Man & Duysters, 2005; Vermeulen & Barkema, 2001). Furthermore, M&As may raise the overall R&D budgets of companies involved (De Man and Duysters, 2005). The absorption of complementary external technological capabilities and the higher R&D budgets allows companies to reap economies of scale and enables them to tackle larger R&D projects than each individual firm could have done. In this way, fundamental research may receive more attention, leading to more advanced technologies being developed. Also, a larger budget enables a company to enter into more research projects, thus spreading the risk of innovation. This may have two effects: either an innovation emerges which would not have been possible without the collaboration or an innovation is realized much faster than when the partners would not have collaborated (De Man and Duysters, 2005).

Resource deployment

Resource deployment is the use by a target or acquiring business of the other business' resources. After the target company is acquired, the acquiring company can enhance its innovation capability by using the superior innovation capability (proprietary technology, patents, and know-how) of one of the target firms to enhance its own organization and performance. The exploitation of revenue-based synergies (increased market coverage and innovation capability) through acquisition is usually achieved through resource redeployment. Such resource redeployment, could take place without the use of an acquisition if the market for resources was efficient enough to allow firms to exchange their resources. The market failure argument plays a central role in explaining why firms redeploy resources through acquisitions (Capron, 1999).

Corporate control

The acquisition of a company becomes an option if two or more corporations are cooperating and information imperfections or the fact that the true actions of a cooperating company are not observable; negatively influence cooperation between companies or joint-ventures. In these cases firms will first push to non-contractual arrangements like

bargaining or auctioning. However, if the losses associated with these arrangements are also great enough, a merger or acquisition is a viable alternative. As concerns choose to acquire the company that it cooperates with, they naturally become the owner of all the assets and knowledge of the target company. The ownership over the target company gives the acquiring company the right to redeploy the tangible and intangible assets and control the actions those assets (Lehto and Lethoranto, 2006). If acquiring companies want to make sure that information on an innovation that is developed in cooperation with another company is not sold to third parties, acquisition of the other firm is a good solution (Lehto and Lethoranto, 2006).

3.4 Reasons for success and failure

As there are many different motives for M&A, there are also many different reasons for success or failure of M&A. The implementation process of a merger or acquisition not only requires extensive preparation and negotiations, but also intensive post-acquisition guidance (Hitt et al., 1996). Next to this motives for acquisitions can conflict with the best interest of the company, for instance managerial hubris. The literature describes several different reasons why mergers and acquisition are a success or a failure. This paragraph describes the most important ones.

The success or failure of acquisitions is influenced by several conditions including the size ratio between the acquired and acquiring firm, the buyer's previous acquisition experience, the degree of business relatedness of both companies, and the degree of friendliness of an acquisition (Gerpott, 1995). Even if the conditions are all optimal, implementing M&A can create special problems. Most of these problems reflect the fact that there are large operational, functional, strategic, and cultural differences between the bidding and target firms involved in M&A. This is caused by the fact that the firms involved in M&A have had a separate existence, separate histories, separate management philosophies, and separate strategies (Barney, 1997).

The implementation of a merger or acquisition will require large amounts of time and money; they may require significant and often unforeseen changes on the part of the acquirer. Companies make the mistake of not appreciating that an acquisition may require as much, or indeed greater, change on their part as for the acquired business (James et al., 1998). The changes that are necessary involve among others adapting strategies for both acquiring and target firm, probably resource deployment. The time and money that has to be spent on fixing these problems can not be spent on other aspects of the operational management. This will negatively influence the performance of both acquiring and target firm. However, the time and effort that has to be spent on implementing M&A depends on the state of fluidity the acquiring firm is in. If an acquiring firm has done recent takeovers it is to be expected that the firm is in a more fluid state than comparing firms without any takeover experience. The more fluid a firm is, the more likely it is that the implementing of a target firm is done without any problems (Hitt et al., 1998). There are several other aspects that positively influence the implementing process of a target firm. The first one is that managers should realize that the combined exercitation of pressure to obtain quick return on the acquisition investment along with the presumption that the management practices of the acquiring firm are superior will negatively influence the implementation process (James et al., 1998). Second, deliberate and systematic acquisition planning processes can facilitate the purchase of an acceptable target firm with terms that can stimulate high financial performance and innovation (Hitt et al., 1998). Furthermore, to realize the full value of any strategic relatedness that exists between a bidding firm and a target firm, the merged organizations must be appropriately organized. For example, to realize economies of scale from an acquisition, bidding and target firms must identify complementarities and coordinate these functions that are sensitive to economies of scale (Barney, 1997; Hitt et al., 1998). It turns out that resource complementarities are more important than the product/market relatedness of specific acquisitions (Hitt et al., 1998).

The long term performance of firms is bound to be negatively influenced by acquisition due to the fact that it is likely that the focus of acquiring firms will experience a shift from strategic controls towards financial controls (Hitt et al., 1996). As a firm acquires new units, the top corporate executives' span of control increases, and also the need for them to process information grows. Their information-processing capacities become strained,

and they often change from an emphasis on strategic controls to an emphasis on financial controls, since financial controls are more easily used to evaluate a company's performance objectively. This change is important because the results of Hitt et al. (1996) show that (a) strategic controls have a positive effect on internal innovation and (b) financial controls have a negative effect on it. Financial controls establish financial targets whereby division managers become increasingly oriented toward the short term and reduce long term investments, e.g., in new product development (Hitt et al., 1996).

Another factor that is bound to negatively influence the acquiring firm is the fact that transaction costs and acquisition related activities absorb managers' time and energy. Because of these transaction cost, managers have little time left managing other important projects and will become more risk adverse. This will cause managers of both acquiring and target firm to postpone important decisions concerning long-term investments like R&D expenditures (Hitt et al, 1996). A question that can be placed with this point of view is that in the case of large firms that have had previous experience with M&A, the implementation of a new M&A will be done quite smoothly and thus not take up as much time and costs as is predicted. It leaves managers with enough time to manage other important projects. Another example is the acquisition of a small firm by a relatively larger firm; in that case the impact of the acquisition will not cause many problems.

The arguments that are mentioned above are either related to performance in general or the innovative performance in specific. The following arguments are specifically for the innovative performance of firms and are derived by the innovation scholars. The positive relation between acquisitions and innovation that is found can be explained by the fact that an acquisition increases the knowledge base and the resources that are available to the newly created firm (Ahuja & Katila, 2001; Cloodt et al., 2006). Acquisitions have an advantage vis-à-vis other options of knowledge attainment in reducing the uncertainty for the acquiring firm by obtaining a critical mass of expertise (Van Beers and Sadowski, 2003).

Although innovation scholars have found that M&A can stimulate innovation, under the right circumstances, it still remains the question whether these results truly reflect the longitudinal performance of the newly formed firms. This has something to do with the methodology used by, i.e. Ahuja and Katila (2001). They have used a distributed lag analysis, in which they have studied a change in innovative performance after the merger or acquisition. This methodology studies the post-acquisition innovative behavior of the acquiring firm, but does not study the longitudinal innovative behavior. With this methodology the outcome the post-acquisition innovative behavior can be influenced through an acquisition that is done in the year following the first acquisition. The second acquisition will be seen as new acquisition and the innovative behavior of years that are followed by the acquisition will be measured. A solution would to perform a longitudinal research that focuses more on the companies involved and less at the fact whether an acquisition has been made.

3.5 Conclusion

Despite the fact that acquisitions are a very important firm expansion strategy scholars still have not reached a consensus on whether the influence of acquisitions on the firm's performance is positive or negative. For some countries and industries a positive relation is found but in general, the tendency seems to be that acquisitions negatively influence the performance of firms. The studies that are presented in this chapter do not measure the influence of acquisitions on the productivity growth of companies and there are almost no recent studies of acquisitions and performance of Dutch companies.

4. Methodology and Data

4.1 Introduction

Compared to previous studies on the influence of acquisitions on the performance of firms the used methodology and data are different in the following ways: first, it utilizes a conceptual model that uses productivity growth as measurement of performance. Second, it applies a new methodology to describe the acquisition activity of firms. This new methodology is the DYNAMO-Program. Third, the study brings the innovation data of Statistics Netherlands from business unit level to company level.

This chapter first deals with the conceptual model that is used. The composition of the model is provided along with the variables that are used in the model. The expected signs and influence on the productivity growth that is estimated are also provided. The second part of the chapter provides a detailed background of the data sources that are used. Three datasets are created for this study; they are based data sources from the MICRONOOM-Program. This part starts with a short description of the background of the MICRONOOM-Program. Then the data sources that are relevant for the study are described in detail. This part also describes the aggregation of the CIS data from business unit level to company level. The third part of the methodology and data chapter deals with the DYNAMO-Program. This program is developed during my internship at Statistics Netherlands. Its main is goal to create a framework that describes firm dynamics. As this study is confined to the acquisition activity of companies the methodology of the DYNAMO-Program is explained from the perspective of acquisitions. The fourth part of the chapter consists of a description of the process of the creation of the three datasets by combining the previously mentioned data sources. Finally, the most important conclusions of the chapter are provided.

4.2 Conceptual Model

The goal of the empirical analysis is to determine what the effect is of acquisitions on the performance of companies. The two previous chapters have set a framework for the different level of identification at which economical statistics are available and described the theoretical background for the decision making processes that are related to M&A. These two aspects are needed to explain why the research studies the influence of acquisitions at company level instead of a lower business unit level. The first important aspect is the fact that this research studies the influence of acquisitions on productivity growth at company level. In paragraph 2.3 the definition of company level is provided. The economic data that is collected at company level corresponds to the consolidated domestic account of a cluster of related business units. This means that the company level is the highest level of economic micro data that is available. The other level at which economic micro data is collected is business unit level. However, business units are often subsidiaries, daughter or sister business units, or part of a conglomerate. When the associated legal entities are majority controlled by a group leader, it is likely that key decisions will be taken with a view to benefiting the whole group (Diederen et al, 2005). The decision of firms to get involved in acquisitions is likely to be taken when the characteristics of the entire company are taken into account. Therefore it is more appropriate to study the influence of acquisitions at the company level than at the business unit level. When, for instance, the efficiency theory lies at the basis for the acquisition decision, the goal for company to reap benefits from the acquisition through synergies. It can be expected the economies of scale can be realized at business unit level, but when economies of scope or financial synergies are the goal of the acquisition it is more likely that these synergies are reached at the level of the entire company. Again, it is important to realize that business units are statistical constructs that might not actually exist as separate legal or fiscal entities and that a company exists as a group of legal or fiscal entities.

The main question is answered via a regression analysis and the model that is used is based on a Cobb-Douglas production function as used by Crépon et al. (1998)[9]. The Cobb-Douglas function states that labor, capital, and technology characteristics determine a firm's productivity. These three variables are the basis of the model. Besides these three variables several other variables are added to control for other firm aspects. The acquisition activity of companies is measured two-fold; first it is studied without any lag, and secondly a short lag is taken into account. This will help to determine if there is a change in the influence of acquisitions over time.

In the empirical model that is formulated the dependent variable is a measure of labor productivity growth from t-2 to t. The following equation for productivity growth is estimated:

$$\Delta \text{ Productivity}_i = \beta_0 + \beta_1 \text{Size}_i + \beta_2 \text{Capital}_i + \beta_3 \text{Innovation intensity}_i + \beta_4 \text{Acquisition activity}_i + \beta_5 \text{Productivity}_{i,t-2} + \beta_6 X_i \quad (1)$$

The exploratory variables are size, capital, innovation intensity, acquisition activity, and the productivity at t-2. Besides the exploratory variables $\beta_6 X_i$ is a vector of exploratory variables that control for other firm aspects; it includes industry, and technology push, and demand pull dummies. Productivity growth is the growth in value added[10] per employed person and is measured the following way: $\Delta\text{Productivity}_i = \text{Productivity}_{i,t} - \text{Productivity}_{i,t-2}$. Besides the acquisition activity the explorative variables are measured at t-2.

The variable size is the number of persons that are employed in a company. Although results from previous studies are mixed, it is to be expected that size has a positive influence on productivity growth. It is likely that there are positive returns to scale in the manufacturing sectors. Other studies that have used the same data sources have also found a positive influence of size on productivity growth (e.g. Belderbos, 2004). However there are other studies that used other sources that have found negative results (e.g. Crépon et al., 1998). The variable size is normalized with a log-transformation.

Capital is amount of assets per employed person; a large amount of capital per employed person will stimulate the productivity of a company. So it is to be expected that capital per employed person has a positive influence on the productivity growth as. This connection has also been found in other studies (Crépon et al, 1998). The variable is normalized via a log-transformation.

The variable innovation intensity is the total innovation expenditures divided by the total turnover of a company. Total innovation expenditures measures all the expenditures that are done by a company that are related to innovation and include: hardware, intramural R&D, extramural R&D, other external technology, innovation implementation, marketing, and training. Innovation intensity is an innovation input variable and it always remains the question whether the resources that are devoted to innovation result in a higher innovation output. Despite this uncertainty innovation intensity still remains a good indicator for the innovation activity of companies. It is to be expected that innovation intensity has a positive influence on the productivity growth of companies as innovation is still one of the most important driving forces of economical growth (Franko, 1989). The variable is log-transformed to normalize it and the value '1' is added before that transformation to include the companies that do not have any innovation activity at all.[11]

Acquisition activity is measured by dividing the number of employed persons of the business units that are acquired during the year by the number of persons that are employed by the acquiring firm at the end of the year. In this model two periods of acquisition activity are measured; the first period is at t-1 and the second is at t. The variable log-transformed to normalize it and due to the fact that the majority of companies does not make any acquisitions the value '1' is added to the ratio before the log

[9] Although the basis of the model is based on Crépon et al. (1998), it is operationalized differently. Crépon et al. (1998) have used a several stage model because they want to overcome problems with the endogeneity and selectivity of the innovation output into the productivity equation. Due to the fact that a larger data set is used in this study, are those problems not relevant.

[10] Value added is an addition of the operating result and the wages.

[11] The addition of the value '1' is done t include those cases that originally have value '0' for the variable. After the log transformation the value of the case will be '0', as the ln(1)=0.

transformation. The fact that the acquisition variables are gathered at a later date than data on innovation intensity is will mean that the innovation variable is not influenced by the acquisitions that were made. This eliminates endogeneity problems that could occur between acquisition activity and innovation intensity as describe by among others Ahuja and Katila (2001). The variable that describes acquisition activity originates from the DYNAMO-Program; the data chapter will explain in detail how that variable is created. The previously published literature on the subject of acquisitions has not reached a consensus on whether acquisitions have a positive or negative influence on productivity. There are both numerous advantages and disadvantages of acquisitions as a expansion strategy. One could argue that the short term effects of an acquisition will influence productivity positively. As an acquisition most of the time is paired with successful short term restructuring, the acquiring company is likely to cut away the nonperforming parts of the acquired company and will therefore easily increase the productivity of the acquired company. This can also be explained by the fact that financial controls will become more important in the aftermath of an acquisition (Hitt et al., 1996). Since financial controls focus on the short term, it is to be expected that the acquiring company will perform better shortly after the acquisition. On the other hand, the argumentation can be made that the shock of the acquisition will slow down the day-to-day processes and therefore negatively influence the productivity of companies. In the long term, it is to be expected that the acquisitions negatively influence the productivity of the acquiring companies. As already shown in the literature chapter, the implementation of an acquisition into the acquiring firm and the adjustment of the acquired company to the strategy of the acquiring company is a delicate process with a high failure rate. This will cause the majority of acquisitions to negatively influence the productivity growth rate of the acquiring companies. The long term productivity growth will be negatively influenced by the short term financial controls after the acquisition. To conclude, it is not clear what the short term effect of an acquisition will be, but the long term effects are expected to be negative.

Besides the most important variables, size, capital, innovation intensity, and acquisition, a vector of exploratory variables is also added to the model. This vector includes other firm characteristics like a technology push and demand pull variable, industry dummies, and variable that control for the productivity in t-2, and is based on the study by Belderbos (2004). The variables demand pull and technology push are explained briefly in this paragraph, the data chapter will describe the creation of these variables more detailed. Technology push means that a company's new technology has an outside source or is developed in cooperation with an external institution. The technology push factor is a dummy that takes on value '1' if one of the indicators for technology push in CIS is marked as being 'very important', and value '0' if otherwise. If a technology is pushed it is not clear that it will be a market success; it could be that it concerns a new technology for which there is no demand from the market. Therefore technology push is expected to influence the productivity growth negatively. Demand pull indicates whether there has been the need to open-up a new market, extend the product range, or replace product that are being phased out. The variable demand pull is a dummy that takes on value '1' if one of the CIS indicators for demand pull is marked as being 'very important' and '0' otherwise.

In order to eliminate any differences between the sectors, an industry dummy is used. It is created using a refinement of the SBI classification of companies that is used by Statistics Netherlands. The classification is based on previous research done by Raymond et al. (2004) and can be found in Appendix 1.

The final variable is the productivity at t-2. According to Belderbos et al. (2004), such a variable partly adjusts for unobserved firm attributes that are relatively constant over time. Since firms that are on the frontier of productivity are less likely to achieve high growth rates then are followers, it is to be expected that the value of β_5 lies between -1 and 0. If β_5 equals zero the productivity frontier effect is absent and there is no gradual convergence between leading firms and productivity laggards. If β_5 is -1, then a productivity lead in the previous period is fully neutralized in the next and past productivity has no impact on future productivity levels (Belderbos, 2004). Since the model also includes a full set of industry dummies, this variable can also be interpreted as the effect of the productivity level of the firm relative to the industry mean in t-2 (Belderbos, 2004).

The expected theoretical signs of the independent variables that are mentioned above are summarized in Table 1 below.

Table 1: The exploratory variables and their theoretical sign

Variable	Productivity growth
Size	+
Capital	+
Innovation intensity	+
Productivity t-2	-
Technology Push	-
Demand Pull	+
Acquisition activity t-1	-
Acquisition activity t	-/+

The influence of acquisition on the performance of companies is specifically studied at the company level because the decisions concerning acquisitions are taken at the highest company level; the same accounts for decisions concerning innovation (Diederen et al., 2005). Although it is likely that several business units of the company are influenced by the decision to acquire another company it is not to be expected that every business unit is affected by the acquisition. As an acquisition causes a redistribution of resources, it can cause effects that level each other out at company level but are significant at business unit level, and vice versa. Economies of scale or scope that are realized through an acquisition can influence the performance of one business unit of a company negatively and positively influence the performance of the other business unit of the same company. The operational problem with the use of BEs with data from Statistics Netherlands is that the aggregated results of financial statistics at BE level do not correspond to the results of the financial statistics at company level.

4.3 Data sources

For this research Statistics Netherlands has provided both the data sources that are necessary to execute this research and the knowledge of how to handle these files. The files used are part of the MICRONOOM-Program, which is an integration program that combines all microeconomic data that are collected by Statistics Netherlands into a set of merge-able data files. The files are the General Company Register (*in Dutch*: Algemeen Bedrijven Register or ABR), the Community Innovation Survey (CIS), and Financial Statistics of Companies (*in Dutch*: Statistiek Financiën van Ondernemingen or SFO). There are several important differences between the files in the MICRONOOM-Program that prevent them from matching. These differences are, for instance, the fact that information is collected at different identification levels, questionnaires are not surveyed with the same frequency, and the sample size differs between the files. This paragraph will first explain the background of the MICRONOOM-Program and after that the characteristics of its most relevant files for this study are described. This also includes the process of the aggregation of the CIS files.

4.3.1 The MICRONOOM-Program

The MICRONOOM-Program is an integration program that combines all the microeconomic data that Statistics Netherlands collects into a set of merge-able data files. The data files it contains involve production statistics, investments statistics, international trade statistics, R&D statistics, and financial statistics. These files are all underwent some transformation in order to become merge-able; these transformations involve, for instance, the creation of comparable sets of variables, the introduction of a measurement at the beginning or end of the year, etc (Diederen, 2000). The original files are not merge-able as they differ too much from each other. Although the files in the MICRONOOM-Program are merge-able not every file can be combined with another. This is caused by the fact that there are differences in the level of the identifier that is used. A comparison between files that collect data at business unit level and company level can be done, as the relation between these two identifiers is known, but this comparison should be done carefully. Although the MICRONOOM-Program is described above as a collection of files, it is important to realize that the MICRONOOM-Program not only contains merge-able data files but also the accumulated knowledge of how to transform and merge the original data files that are delivered from the sectors within Statistics Netherlands that provide the original data. In other words, it is more than just a collection of files.

Below the most important characteristics of the most relevant files for this study will be given. The most relevant files are the General Company Register, the Community Innovation Survey, the Production Statistics, and the Financial Statistics of Companies.

4.3.2 General Company Register (ABR)

The General Company Register *(Algemeen Bedrijven Register = ABR)* is a division of Statistics Netherlands that collects information on business units (BEs) and companies (ONDs). This information is gathered in several different files. For the business units they determine the number of employed persons, the economic sector it is active in, the company they belong to, and they record changes in the BEs structure through mutation codes. For companies they collect which business units the companies own and they describe changes in the companies' structure through mutation codes. This information is put in a unit register that is called the ABR file. The ABR file consists of yearly/quarterly data files that act as the statistical framework for the economic statistics that are collected by Statistics Netherlands. A characteristic of a register is that it does not samples but collects data of the entire population; in this case the ABR file holds data for all the business units and companies that are active in the Dutch economy during a year. During the period between the beginning of 1995 and the end of 2004 the division ABR has gathered information on almost 1.9 million business units and almost 1.7 million companies. The ABR files are yearly or quarterly and are not longitudinal orientated.

Although the ABR files acts as the backbone for all the economic statistics of Statistics Netherlands it can not be used for longitudinal research into the dynamics of firms. This is firstly caused by the fact that individual files are not merged and secondly the mutation codes can not be used for the mapping of dynamics of firms. Previous exploratory studies done with the original ABR files and the mutation codes by Bert Diederen have yielded no workable longitudinal files that could be used for the explanation of the dynamic behavior of firms. In order to identify, classify, and quantify changes it is necessary to combine the data of the separate ABR files into new files that can be merged with each other. For this purpose the ABR-BE-OND files were created; these files are a simplified version of the ABR. They only hold information concerning the status of a business unit at the beginning and end of each year: the company it belongs to, the number of employed persons, and the economical sector it is active in. These files are merged together to create one file that contains all this information for the years between 1996 and 2004; this file is the ABR-MICRONOOM-Database. Table 2 gives a description of the number of business units, companies, and employed persons that are present in the ABR-MICRONOOM-Database per year for the years 1996 to 2003.

Table 2: Descriptive statistics of the ABR-MICRONOOM file

Year	BEs	ONDs	EMPs
1996	808,024	751,283	5,811,610
1997	825,264	771,282	6,041,129
1998	816,762	788,529	6,326,345
1999	847,495	818,742	6,664,540
2000	874,215	844,827	6,982,999
2001	916,012	883,813	7,172,786
2002	952,160	909,984	7,306,580
2003	958,665	913,134	7,310,194

These descriptive statistics show that on an average a company that is active in the Dutch economy has 1.05 business units and has little more than 8 employed persons. The ABR-MICRONOOM-Database is maybe the most important file in the MICRONOOM-Program as is acts as a backbone for the other economic statistics and can be used to identify the dynamics of firms.

4.3.3 Community Innovation Survey (CIS)

The Community Innovation Survey (CIS) is a European innovation survey that was started to gain insight in the development and diffusion of new technologies in the European countries. The publication of the first Oslo Manual in 1992 by the Organization for Economic Co-operation and Development (OECD) acted as a guideline for the standardization of the collection of innovation data; on this guideline the CIS is based. The statistical agencies of the European countries collect innovation data using the standards as stated in the Oslo Manual. These standards make the national results comparable.

The first CIS that yielded useful results was the CIS that was executed for the period 1994-1996, and was called CIS 2. CIS 1 was not a success since it was the first time such a survey was executed, and had a lot of child's deceases that made the results of the survey not useful. However, with the findings that came from that first survey, the second CIS could be set up in a way that its results were useful. The European Commission has ordered that the European Countries conduct the CIS once every four year. However, the Dutch government wants the Netherlands to be one of the forerunners of Europe in innovation and they want insight in the process of innovation; therefore they believe a higher frequency of innovation surveys is necessary. So Statistics Netherlands executes the CIS every two years. The CIS that are that are necessary for the EC are numbered with whole numbers, the CIS that are done at the Statistics Netherlands' initiative are given the addition ,5 (or ½); Table 3 gives an overview of the years the CIS is executed and the corresponding CIS numbering. In the year that lies between the CIS, Statistics Netherlands also conducts a R&D survey. This is a reduced version of the CIS and surveys the most important variables like innovation expenditures and the size of the R&D staff.

Table 3: CIS numbering

Year	CIS #
1994 - 1996	CIS 2
1996 - 1998	CIS 2.5
1998 - 2000	CIS 3

The CIS are not specifically designed for longitudinal research. This means that, despite that around 35 variables stay the same in the different CIS; other variables vary from CIS to CIS. This leads to some serious problems regarding longitudinal research. For longitudinal research it is important that the same variables are measured every time a survey is done. Despite the fact that in general the most important other surveys of Statistics Netherlands are not specifically designed for longitudinal research, their variables do not change; the only thing that changes in these surveys is the sample[12]. Before the separate CIS could be merged into a longitudinal file, it was necessary to create a framework that could straighten out the differences between the variables. The variables were compared with each other, some variables were transformed, others combined into new variables, and new variable names were created to make it possible to combine the different CIS into one longitudinal file. A good example of this process is the renaming and changing of the variable total innovation expenditures; this variable is called UITOTA in both CIS 2 and CIS 25; in CIS 3, 35, and 4 it is called RTOT. These variables can not be put together in one file, since there is an overlap in the names. For the uniformity the following name was chosen RDEXPE**XX**, where **XX** is replaced with the corresponding CIS number; for CIS 2 it is 20, for CIS 25 it is 25, etc. In case of the variables that are concerned with the goal or the effect of an innovation, these differ from each other almost in each CIS; in CIS 30 they are not available.[13] Another difference between the CIS is that the sample selection changed from 2002 on; before 2002 the research population was business units with 10 or more employees and for the periods from 1996-1998 and 1998-2000; companies with 1-10 employees were also surveyed. From 2002 on the research population are companies with 10 or more employed persons[14] (www.cbs.nl). Since the CIS is not designed for longitudinal research not every variable is questioned in every CIS. For this research the variables that are related to technology push and demand pull cause a problem as they are not surveyed in CIS 35.

[12] The change of the sample is mainly caused by the fact that the Dutch government want to keep the survey load (in Dutch: *enquêtelast*) for companies as low as possible. If small companies are in a survey of Statistics Netherlands the one year it is likely that they are not the other. Although this applies for almost all the economic statistics of Statistics Netherlands, it turn out that this is not completely true for the CIS. According to Bert Diederen of Statistics Netherlands, the division that surveys the CIS takes into account the companies that are involved in innovation; if they know that a company is involved in innovation they will survey it the following time. This leads to a sample that is not an a-select sample. The surveying of the larger BEs is not hampered by this survey load, so they will be consistently in the sample.

[13] A complete overview of the availability and transformations of the variables in the CIS can be applied for at the author.

[14] www.cbs.nl, Home, Methoden, Innovatie-enquete, checked, November, 2007.

Aggregating CIS

The CIS is collected at BE level. This means that in order to get company totals for innovation variables an aggregation step needs to be made. There are several arguments that support the aggregation of the CIS. However, it needs to be borne in mind that there are several problems that can occur with this aggregation. This paragraph provides information on the relation between BEs and ONDs that is CIS specific, some arguments in favor of the aggregation, and some empirical results that provide more information on the aggregation.

The Oslo Manual provides an extensive guideline that national statistical agencies need to follow when executing the CIS. These guidelines are made to keep the international results comparable. One of the aspects that is important for comparability is the unit of measurement. The introduction already explains that Statistics Netherlands uses a legal units, business units, and companies to collect economic micro data. For the collection of the CIS data the identifier business units is used. This does not correspond to what is stated in the Oslo Manual on the topic of the reporting units. The Oslo manual states the following on the reporting unit: "Taking into account how innovation activities are usually organized, the enterprise-type unit is the most appropriate statistical unit in innovation survey in many cases"[15] (Oslo Manual, 1992). The definition of enterprise that is referred to is the definition by Eurostat. Again it is important to realize that the definition of enterprise does not correspond to the commonly used term company. An enterprise is a statistical unit that is the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. In contrast, the unit company holds the consolidated totals for the domestic accounts of a group of enterprises. The chapter that describes the research framework has already stated that a business unit, defined by Statistics Netherlands, is not the same as an enterprise, defined by Eurostat.

Diederen et al (2005) have argued that the company level is a more adequate level for the analysis of innovation data. Enterprises or business units are often subsidiaries, daughter or sister business units, or part of a conglomerate. When the associated legal entities are majority controlled, it is likely that key decisions will be taken with a view of benefiting the whole group. A model of optimizing behavior that is appropriate at the group level may be inadequate to describe the decisions taken at the enterprise level. When it comes to issues like R&D, even legally independent firms may form networks, R&D joint ventures, or technological alliances, in which part of the R&D is conducted jointly for reasons of cost sharing, risk sharing, and complementaries (Diederen et al, 2005).

In order to get the innovation data of the CIS from BE level to OND level an aggregation is made. This aggregation step is based on Diederen et al. (2005). They are the first to aggregate CIS data for the Netherlands to enterprise cluster or company totals. The CIS variables can be aggregated from BE to company level by aggregating all the business units to the company they belong to. The BE-OND relation is found in the ABR-MICRONOOM-Database. As the BE-OND relation is described with a fixed point variable and the CIS variables often describe the situation during an entire year, an appropriarity problem can arise.

An example of such a problem is the divestment of a BE during a year; the problem is to which company the innovation characteristics need to be appropriated. This problem is neglected by Diederen et al (2005). This study solves this problem by making the assumption that if a business unit that is in the CIS is divested during a year the innovation characteristics of that BE influences both the divested and the acquiring company. In case of a dummy variable, both companies will get value '1' for the aggregated value if the dummy variable is '1' at the BE level. In case of a ordinal and a stream variable, like innovation expenditures, the value at the end of the year is divided between the two companies that are involved in the acquisition; the assumption is made that the BE is divested at the 1st of July of that year and during the two half years the

[15] Enterprise is defined as "the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision making, especially for the allocation of its current resources. An enterprise carries out one or more activity at one ore more location". (Council regulation (Oslo Manual p 91)).

innovation expenditures were the same. The DYNAMO-Program is used to identify the business units that are in the CIS and are divested and acquisition during the year.

The CIS is partly a sample; BEs that have more than fifty employed persons are surveyed every CIS, the smaller BEs are sampled. Furthermore, according to Bert Diederen, Statistics Netherlands has knowledge on which BEs of a company are innovative. These BEs are surveyed for the CIS. Despite these facts it can still happen, that for a company with more than one BE, only the BE is surveyed that does not show any innovation activity whereas the other BE is innovative. When the results of the company are aggregated, the company will not show any innovation, despite the fact that it should be registered as an innovative company.

Appendix 2, Appendix 3, and Appendix 4 present the distribution of the companies that are in the datasets that are used in this study. The tables are cross tables; the columns show the frequencies of the total number of BEs per company, the rows provide the number of BEs that are in the CIS. Per company it shows how many of the total BEs are also in the CIS. For a large number of firms not all the BEs are in the CIS. This could indicate that the previously mentioned problem could exist. When this problem is applied at the variables technology push and demand pull the following is found. For the variable technology push, 399 companies out of the 1121 have reported a '0' and have not all BEs in the CIS 20; for CIS 25, these figures are 340 out of 1034; for CIS 30, they are 212 out of 808. For the variable technology push, 212 companies out of the 1121 have reported a '0' and have not all BEs in the CIS 20; for CIS 25, these figures are 193 out of 1034; for CIS 30, they are 78 out of 808.

Appendix 5 through Appendix 10 describes the difference in the results for the variables Technology Push and Demand Pull between BE and OND level. They illustrate that on average the number of ONDs that have value '1' for both the variables is higher than the number of BEs. This is caused by the fact that during the aggregation, the maximum of these variables is taken so if one of the BEs that are owned by a company has the value '1' this will accounts for the entire company. The only problem that can arise is with the occasion that BE that is owned by a company is not part of the sample of the CIS and not measured but other BEs that are owned are part of the CIS sample and measured; if the BEs that are part of the sample all have the value '0' and the BE that is not measured has value '1', the value for the entire company will be '0' where it should be '1'. It is to be expected that this problem will not influence the values of the companies as the CIS consistently measures the largest BEs and therefore it is to be expected that the BEs that are not measured are the smaller BEs. If the largest BEs in a company do not report any Technology Push or Demand Pull it is likely that the smaller BEs will also not have experienced any of these factors. This line of thought can not be tested as there is no data available to test it so the assumption is made that this problem does not occur. Appendix 11 shows the difference in the average innovation expenditures[16] for both BEs and ONDs; it shows that on average the innovation expenditures are higher at the OND level than at the BE level, as is to be expected. For this variable it is likely that the innovation expenditures are slightly underestimated as some BEs that have made innovation expenditures are not part of the CIS sample and therefore not measured. The assumption is made that this slight underestimation will not influence the study, again due to the fact that the largest BEs are part of the sample and that only the small BEs are not measured. This means that the largest part of the innovation is bound to be measured and only small parts are not.

It is to be expected that the innovation activity is underestimated, due to the fact that not all business units are in the CIS. This could be a problem for an aggregation of CIS data from BE to OND level, like the one is done in this research. This study acknowledges this problem, but makes the assumption that this problem does not exists and that the innovation activity is not underestimated. It is recommended that further research is done to deal with the problems that are put forward in this paragraph.

4.3.4 Production Statistics

The Production Statistics (PS) collect the most important of the profit-and-loss accounts of non-financial enterprises. Before September 2000 the following eight sectors of Statistics

[16] Innovation expenditures are the total expenditures on innovation.

Netherlands were responsible for the production statistics belonging to their part of the Dutch economy: commercial services, transportation, industry, construction, environment, energy, integration and presentation, and legal protection and security (Ouwehand, 2004)[17]. The fact that these different sectors all were responsible for their own part of the Dutch economy and there was no general agreement in the variables that were surveyed and how these variables were processed caused numerous troubles in the process of combining these datasets into one file that could be used for the analysis of the PS. The MICRONOOM-Program has set up a framework for the matching and merging of these different PS files. This framework works with circuit and accounting diagrams to form a coherent file that holds the information from the different sources under the same variable names, in the same format, etc.

As is mentioned above the PS collects data at the enterprise or business unit level. If this data is aggregated to the enterprise cluster level, it turns out that there are differences between these results and the results that are collected at cluster of enterprise level or company level. This is caused by the fact that there are on average almost 900,000 business units active in the Dutch economy and the sample size of all the PS combined is around 40,000 business units. The results of the PS are weighted to get the estimated results for the entire economy. However, there always will be differences between the estimation and the actual values of the variables. The problem of the level up of data will be further dealt with below. Due to the fact that not all business units have values for the PS, the PS will not be used in this research. Since this research wants to examine the influence of acquisition at company level the aggregated results of the PS can not be used.

4.3.5 Financial Statistics of Companies

The Financial Statistics of Companies (in Dutch: *Statstiek Financiën van Ondernemingen, SFO*) is based on the annual accounts of companies. Statistics Netherlands makes a distinction between large companies, which have a balance sheet total of over 23 million Euros, and small companies who have a balance sheet total less than 23 million Euros. This difference is translated in the fact that there are two different financial statistics: Financial Statistics of Large Companies (in Dutch: *Statstiek Financiën van Grote Ondernemingen, SFGO*) and Financial Statistics of Small Companies (in Dutch: *Statstiek Financiën van Kleine Ondernemingen, SFKO*). The Dutch abbreviations SFO, SFGO, and SFKO will be used from now on. Both the SFGO and the SFKO aims at non-financial companies.

The SFGO is based on a survey that is held among 2,500 large companies, the figures are based on the balance sheet, the profit-and-loss accounts, tangible and intangible assets, and the mutations of the balance sheet. As large companies are often made up of clusters of enterprises that exist in complicated structures, Figure 1 is an example of how such a structure can look like. As can be seen in Figure 1 there is still one parent company that has the full authority of the enterprises. In the SFGO the results of the profit-and-loss accounts and the balance sheets of the individual enterprises are consolidated. This consolidation results in the elimination of mutual deliveries and debts that exist between the enterprises. This consolidation leads to other results then when the individual profit-and-loss accounts and balance sheets are aggregated. It is important to realise that the results of the foreign subsidiary enterprises are not taken into account in the SFGO.

The SFKO is based on a database of the Dutch Ministry of Finance. In this database a large number of figures from the questionnaire of the corporation tax (in Dutch: *Vennootschapsbelasting*) are used. This database also contains a balance sheet for financial accounts. Statistics Netherlands is allowed to use this database for statistical purposes. Since the SFO collects data at the level of clusters of enterprises, this will be the source for economic statistics that are needed in this research.

4.3.6 Other economic statistics

Along the economic statistics that are mentioned above, there are several other economic statistics that are collected by Statistics Netherlands and are present in the MICRONOOM-Program. These are the investment statistics and the international trade statistics. Both

[17] In Dutch: *commerciële dienstverlening, transport, industrie, bouw, milieu, energie, integratie en presentatie, rechtsbescherming en veiligheid.*

are collected at the enterprise level. These statistics are only mentioned and not explained in detail.

4.4 DYNAMO-Program

The previous paragraph describes the most important files of the Micronoom-program. These files all have been available for research in the past years. For this research a new framework was created that describes the dynamics of companies, the DYNAMO-Program. The goal of the DYNAMO-Program was to develop a framework in which the dynamics of firms can be identified, classified and quantified. The term firm relates to the ultimate beneficial owner of a group of business units, or the headquarters of a firm. The outcome of the development of this framework consists of a longitudinal file that describes the changes of all companies that were active in the Dutch economy between 1996 and 2003 and the syntax that was used to created this file. For this research variables that describe the acquisition activity of companies are the most relevant. In the next paragraph the development of DYNAMO is explained with the acquisition variables as the main point of interest. A complete description of the creation of DYNAMO, which is described the Statistics Netherlands memorandum: Dynamo: Dynamics in enterprise clusters by Diederen and Ophuis (2007).

In the framework several aspects of the dynamics of firms can easily be singled out and studied. The DYNAMO-Program has several advantages compared to other more traditional methodologies. An example of a traditional method of mapping acquisitions of companies is to collect announcements that are made concerning acquisitions in the professional literature. The advantages of the DYNAMO-Program are the following: (a) The DYNAMO-Program studies changes within a firm at the highest level of aggregation of microeconomic data, the ultimate beneficial owner level. This is the level at which long term strategy decisions are taken, so it would be obvious to study the influence of these decisions at this level. The DYNAMO-Program is not just limited to acquisition, but also provides information of other aspects of firm dynamics like, spin-offs, Greenfield entries, divestitures, etc, at the UBO level. (b) The DYNAMO-Program contains variables that describe the acquisition activity, and other dynamics, as a percentage of the number of employed persons or business unit. This is in contrast to acquisition dummies that are used in other studies (e.g. Van Beers & Sadowski, 2003). In the future this can be expanded with other aspects. The measurement of acquisitions as a percentage creates new possibilities to measure the influence of acquisitions on business processes. (c) Future research can adjust the DYNAMO-Program to get more detailed classifications regarding the currently used variables. (d) The DYNAMO-Program can be expanded in the future with, for instance, information on the employed persons, using other data sources from Statistics Netherlands. (e) The DYNAMO-Program is based on the business register of Statistics Netherlands and so it holds information on the dynamics of almost 1.7 million companies and 1.9 million business units that have been active in the Dutch economy for the last decade. The points above indicate that the DYNAMO-Program has a lot of advantages compared to other methodologies that are used and it has a high potential. It is recommended that this potential is utilized in future studies.

In order to create the DYNAMO-Program, the ABR-MICRONOOM files that describe the relation between business units and the company they belong to at the beginning and the end of each year were used. The period that this file describes runs from 1996 to 2004. This longitudinal file can be used to describe the structure of a company and its changes by analyzing the business units that the company owns. For each year the dynamics of firms are identified in two steps; these steps are explained below.

The following describes the methodology of DYNAMO; the example of the divestiture of a large amount of business units by Laurus to Ahold during 2006 is used to explain it. Table 4 shows a simplified representation of this divestiture/acquisition as it can be found in the ABR-MICRONOOM-Database. Table 4 shows that there were 3 business units active in the Dutch economy; at the beginning of 2006 the BEs Edah and Super de Boer were owned by Laurus and Albert Heijn was owned by Ahold. At the end of the year, the BE Super de Boer was still owned by Laurus, but Edah changed from owner to Ahold, besides Edah, Ahold also owned Albert Heijn. The variables wp06b and wp07b represent the number of persons that were employed at the beginning of 2006 and 2007; these figures did not change during 2006.

Table 4: The ABR-MICRONOOM-Database, simplified representation

Business Unit	ond06b	ond07b	wp06b	wp07b
Edah	Laurus	Ahold	100	100
Super de Boer	Laurus	Laurus	800	800
Albert Heijn	Ahold	Ahold	1900	1900

As is already stated, for this research the assumption is made that the OND at the end of the year must be the same as the OND at the beginning of the following year. This means that the OND at the beginning of 2007 is the same as the one at the end of 2006. Using this assumption, it becomes clear from Table 4 that the business unit 'Edah' that Laurus owned at the beginning of 2006 was sold during 2006, since it has a new owner at the end of 2006, which is Ahold. It is important to realize, although being obvious, that in the acquisition process of a business unit there is both a divesting company and an acquiring company involved. For the identification of the demographic characteristics, it is necessary to identify that Laurus divests a BE and Ahold acquires one. It also becomes clear that both Ahold and Laurus owned other business units, Albert Heijn and Super de Boer respectively. The ownership of these two business units did not change during the year. The variables ond06b and ond07b describe a situation at a point in time; the DYNAMO-Program compares these two points in time to create a new variable that describes the dynamics of the situation of a BE during a year. It is important to realize that 'dynamics' does not necessary implies that there is a change in the situation of a BE, the BE can stay with the same firm and its number of employed persons does not necessary needs to change.

The fact that there are always two sides of the story with an acquisition is an important aspect of the DYNAMO-Program. For the first side the owner at the beginning of a year is compared to the owner at the end; for the second side the owner at the end of the year is compared to that at the beginning of the year. To operationalize this two side story two different sets of variables are created, the first set represents the demographic characteristics that are linked to BEs at the beginning of the year; for Table 4 this means that the divestiture of 'Edah' is identified. The second set represents the demographic characteristics that are linked to the BEs at the end of a year; for Table 4 this means the acquisition of Edah by Ahold. The two sets of classifications are given in Table 5. These classifications are the basis of the DYNAMO-Program. However these classifications do not capture the entire picture of the dynamics of firms; they completely ignore: new companies, spin-offs, changes in the work force of companies, etc. The DYNAMO-Program is designed so that new variables can easily be added to the existing, just by adding an extra statement in the syntax. This makes it possible to extend the scope of the DYNAMO-Program and measure other aspects of firm dynamics.

Table 5: Standard classifications in DYNAMO

Beginning of the year	End of the year
BE stays at the same firm	BE stays at the same firm
BE dies	BE is born
BE is divested	BE is acquired

As the demographic characteristics of the business units are identified and classified, namely for Laurus a divestiture and a business unit that stayed with the firm, and for Ahold an acquisition and a BE that stayed with the firm, the characteristics can be quantified. This quantification can be done at several levels; the two levels that are done in DYNAMO-Program are at business unit's and employed person's level. First the business unit's level will be dealt with. After the quantification an aggregation step follows, which is also dealt with now. As is already shown, Laurus has had one BE that was divested during 2006 and had one BE that stayed with Laurus during 2006; Ahold has had one BE that stayed continuously at the company and has acquired one BE. This means that the variable 'continue 06b BE', which indicates the number of BEs that belongs to an OND at the beginning of the year and stayed continuously with the same firm during 2006, has a value '1' for the case Laurus and also for the case Ahold. The variable 'continue 06e BE' indicates the number of BEs at the end of the year that stayed continuously with the same firm during 2006; again for both Ahold and Laurus the value is '1', which means one BE. Although these two variables may seem to overlap each other, they are necessary when there is a difference between the numbers of employed persons. This is further explained

in the appendix. The variable 'divestiture 06b BE' that indicates the number of BEs that were owned by a company at the beginning of 2006 and were sold during 2006, has the value '1' for the case Laurus and as Ahold has not divested any of its BEs the variable has no value. Finally the variable 'acquisition 06e BE' indicates the number of BEs that were owned by a company at the end of a year and were acquired during that year. The value for this variable is '1' for the case Ahold, they have acquired the BE Edah, and no value for Laurus. The results of this classification and aggregation can be found in Table 6.

Table 6: Results at BE level

Company	continue 06b BE	divestiture 06b BE	continue 06e BE	acquisition 06e BE
Ahold	1	.	1	1
Laurus	1	1	1	.

The methodology at employed persons (WP) level is the same as that at BE level, the only difference is the fact that the value '1' is replaced for the value of the number of employed persons; the values of the variable 'wp06b' are used for the variables 'continue 06b WP' and 'divestiture 06b WP', the values of the variable 'wp06b' are used for the variables 'continue 06e WP' and 'acquisition 06e WP'. Table 7 shows the results for this quantification and aggregation step.

Table 7: Results at WP level

Company	continue 06b WP	divestiture 06b WP	continue 06e WP	acquisition 06e WP
Ahold	2000	.	1900	100
Laurus	800	100	800	.

The results of the quantification at WP level can be used to discover the relative size of an acquisition. If the total number of employed persons of a company at the end of a year and the number of employed persons that were added to the firm through an acquisition are known, the ratio between these two can be calculated. This ratio gives an indication of the impact an acquisition can have on the acquiring firm. For Ahold the ratio would be 100/(1900+100)=0.05. This ratio is not that high; if the total number of employed persons at the end was 200 and the acquired persons were 100, the ratio would have been 0.50. This ratio does not tell everything about the impact of an acquisition, but it is a start. Further research should try to come up with more sophisticated variables that can describe the influence of an acquisition on the acquiring company; for instance, turnover could be taken into account.

The above paragraph has shown that the DYNAMO-Program can be used to study the dynamics of firms at a specific level. The variables that describe acquisition in combination with the sum of employed persons can be used to study the influence of an acquisition on the acquiring firms. As the DYNAMO-Program is already at the company level it can easily be used for this study's model.

4.5 Final datasets

In order to get the datasets that can be used, first a longitudinal dataset is created that holds the CIS, SFO, and DYNAMO variables. The companies, that have one or more business unit that is surveyed one or more times for the CIS, are used as the starting point of the creation of the longitudinal file. These company numbers are matched to DYNAMO and SFO. As the CIS has the smallest sample this is chosen as the start point. The longitudinal file that was created consisted of 33,070 individual company numbers. From this file the influence of acquisition activity on productivity growth for the years 1996-1998, 1998-2000, and 2000-2002 can be studied.

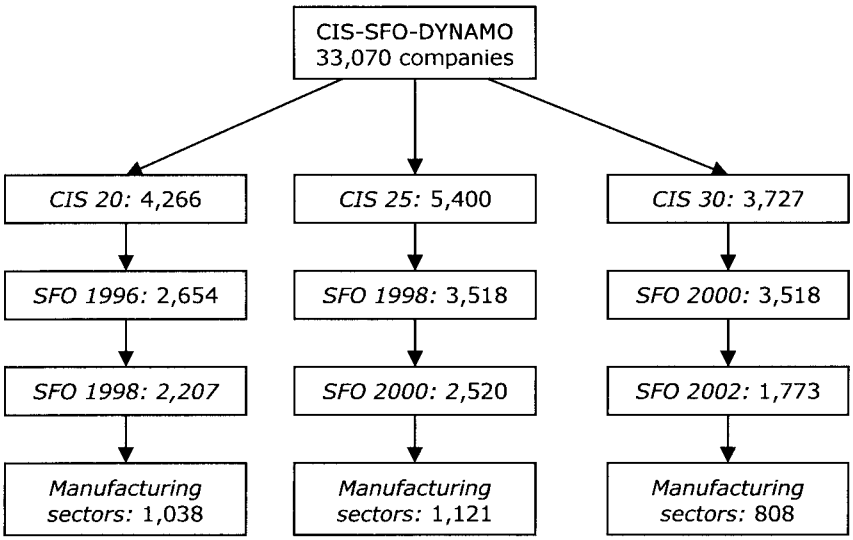
These three periods make a recent analysis possible. Due to the lack of the availability of data was it not possible to study the periods 2002-2004 and 2004-2006. Table 8 describes the availability of the variables over the period of time that there is data available. From this table it becomes clear that there are no technology push and demand pull variables available for CIS 35, so 2002-2004 can not be measured. Furthermore, at this point there is no data available for 2006 so the period 2004-2006 can not be analysed.

Table 8: Source, availability, and time of measurement of the variables

Variable	Source	Availability
Size	DYNAMO	1996-2004
Capital	SFO	1996-2004
Innovation intensity	CIS	CIS 20,25,30,35,40
Productivity t-2	SFO	1996-2002
Technology Push	CIS	CIS 20,25,30,40
Demand Pull	CIS	CIS 20,25,30,40
Acquisition activity t-1	DYNAMO	1996-2004
Acquisition activity t	DYNAMO	1996-2004

The selection of the cases of the three groups is based on whether the variables of the model have a value or not. If the variables have a value for the period that is under research the case is selected. This selection procedure is done in three steps. The first step consists of the selection of the cases that are valid for the CIS variables, innovation expenditures, technology push, and demand pull. The second step is the selection of the cases that are valid for the SFO at t-2, productivity at t-2 and capital. The third step is the selection of the cases that were valid for the SFO at t, productivity at t. The final step in the selection is the selection of the companies that are active in the manufacturing sector. The DYNAMO-Program is not a hampering factor as it holds data on all the companies and business units that are active in the periods. The selection steps are described in Figure 2, along with the number of companies that remained in the three datasets.

Figure 2: Selection of the cases



4.5.1 Descriptive statistics

Table 9, Table 10, and Table 11 give a description of the distribution of the companies across the industry sectors and the number of companies that are in the samples that have made an acquisition. Per table three acquisition dummies are displayed. These dummies show the number of companies that made one or more acquisition during a year. The first dummy describe whether a company has made an acquisition during the year t-1, the second if a company has made an acquisition during t, and the last dummy describes whether a company has made an acquisition during these two years. Per year the number of acquiring companies per sector is compared to the total number of acquiring companies and the share per sector is given.

The three tables show that the samples for the three periods consist of 1039 companies for the period 1996-1998, 1121 companies for 1998-2000, and 808 companies for 2000-2002. Within the samples the four largest industry sectors are in decreasing order: metals, wood, machinery & equipment, and food. the average percentage of companies that have made an acquisition during the two year period is relatively constant around 13% (13%, 13%,

and 14%). The four sectors that show the most acquisition activity are in decreasing order: wood, food, metals, and machinery & equipment. Companies that have made one or more acquisitions during the

If the number of acquiring companies at t-1 and t are added together and compared to the companies that have made one or more acquisition during t-1 and t. For the period 1996-1998 there are 82 companies that have made and acquisition during 1997 and 69 during 1998, the sum of these two is 151. There are 131 companies that have made one or more acquisitions during 1997-1998. This means that there are 20 companies that have made one or more acquisition in both 1997 and 1998. This is just nearly 2% of the total sample in 1996-1998; for the other period these figures are around the 3%. This indicates that there is only a small percentage of firms in the samples that have an active acquisition strategy and make one or more acquisitions every year.

Other interesting aspects that can be found in the tables are the fact that acquisition activity in the food sector diminishes over time. This could indicate that high acquisition activity in the earlier periods have resulted in a more concentrated industry, so there are fewer number of companies to acquire so a lower acquisition activity. The opposite takes place in the wood sector; there the percentage of acquiring companies increases over time. This could indicate that the wood sector was not concentrated and there were opportunities for acquisitions.

Table 9: Distribution of companies across industries and acquisition strategies (for 1996-1998 companies)

SBI	Sector	No. of observation in sample	Share %	Share acquiring firms in 1997	No. of observation	Share acquiring firms in 1998	No. of observation	Share acquiring firms in 1997-1998	No. of observation
15-16	Food	124	11.9	22.0	18	18.8	13	20.6	27
17-19	Textile	66	6.4	2.4	2	4.3	3	3.8	5
20-22	Wood	145	14.0	19.5	16	14.5	10	13.7	18
23-24	Chemicals	78	7.5	6.1	5	13.0	9	9.9	13
25	Plastic	57	5.5	3.7	3	5.8	4	5.3	7
26	Non-Metallic	44	4.2	8.5	7	2.9	2	6.1	8
27-28	Metals	151	14.5	14.6	12	13.0	9	14.5	19
29	Machinery & Equipment	150	14.5	11.0	9	11.6	8	11.5	15
30-33	Electrical	101	9.7	8.5	7	8.7	6	9.2	12
34-35	Vehicle	67	6.5	0.0	0	2.9	2	1.5	2
36-37	NEC	55	5.3	3.7	3	4.3	3	3.8	5
Total		1,038	100.0	100.0	82	100.0	69	100.0	131

Note: See Appendix 1 for a detailed description of the sector classifications

Table 10: Distribution of companies across industries and acquisition strategies (for 1998-2000 companies)

SBI	Sector	No. of observation in sample	Share %	Share acquiring firms in 1999	No. of observation	Share acquiring firms in 2000	No. of observation	Share acquiring firms in1999-2000	No. of observation
15-16	Food	105	9.4	18.3	15	17.2	16	16.2	24
17-19	Textile	61	5.4	6.1	5	4.3	4	5.4	8
20-22	Wood	181	16.1	18.3	15	19.4	18	18.9	28
23-24	Chemicals	108	9.6	9.8	8	8.6	8	9.5	14
25	Plastic	71	6.3	6.1	5	6.5	6	5.4	8
26	Non-Metallic	46	4.1	8.5	7	6.5	6	7.4	11
27-28	Metals	171	15.3	9.8	8	9.7	9	10.1	15
29	Machinery & Equipment	152	13.6	12.2	10	8.6	8	10.1	15
30-33	Electrical	111	9.9	7.3	6	12.9	12	11.5	17
34-35	Vehicle	63	5.6	2.4	2	4.3	4	3.4	5
36-37	NEC	52	4.6	1.2	1	2.2	2	2.0	3
Total		1,121	100.0	100.0	82	100.0	93	100.0	148

Note: See Appendix 1 for a detailed description of the sector classifications

Table 11: Distribution of companies across industries and acquisition strategies (for 2000-2002 companies)

SBI	Sector	No. of observation in sample	Share %	Share acquiring firms in 2001	No. of observation	Share acquiring firms in 2002	No. of observation	Share acquiring firms in 2001-2002	No. of observation
15-16	Food	89	11.0	11.4	9	10.2	6	8.6	10
17-19	Textile	27	3.3	2.5	2	0.0	0	1.7	2
20-22	Wood	120	14.9	19.0	15	30.5	18	24.1	28
23-24	Chemicals	90	11.1	6.3	5	8.5	5	7.8	9
25	Plastic	50	6.2	3.8	3	5.1	3	5.2	6
26	Non-Metallic	33	4.1	10.1	8	13.6	8	11.2	13
27-28	Metals	136	16.8	15.2	12	10.2	6	13.8	16
29	Machinery & Equipment	110	13.6	16.5	13	5.1	3	12.1	14
30-33	Electrical	63	7.8	5.1	4	8.5	5	6.9	8
34-35	Vehicle	43	5.3	5.1	4	5.1	3	4.3	5
36-37	NEC	47	5.8	5.1	4	3.4	2	4.3	5
	Total	808	100.0	100.0	79	100.0	59	100.0	116

Note: See Appendix 1 for a detailed description of the sector classifications

Table 12 provides a contingence table displaying the means of the variables that were used in the models by acquisition behavior. This table gives a first indication that there exist significant differences along key parameters between companies that do acquisitions and companies that do not. Although the samples that are studied vary from year to year, they show a consistent difference between the means.

Table 12: Descriptive statistics for acquiring and non-acquiring companies

	Acquisition during 96-98	No acquisition during 96-98	Mean[a] test F-value	Acquisition during 98-00	No acquisition during 98-00	Mean[b] test F-value	Acquisition during 00-02	No acquisition during 00-02	Mean[c] test F-value
Size/ Employment	1,439	213	127.99***	1,455	187	129.23***	1,096	311	28.11***
Innovation expenditures	15,022	1388	40.59***	14,985	1521	61.56***	9,161	9,267	0.09
Innovation intensity	0.023	0.053	4.96**	0.025	0.040	6.71***	0.042	0.074	4.84**
Technology Push	0.46	0.29	27.07***	0.41	0.22	55.12***	0.51	0.36	10.01***
Demand Pull	0.75	0.59	98.94***	0.72	0.53	199.44***	0.84	0.77	16.94***
Value Added	79,020	12,339	118.49***	101,366	12,717	121.76***	70,179	22,541	16.89***
Value Added per WP	62.63	46.30	13.90***	58.26	49.35	0.01	61.59	58.84	1.67
Assets	441,699	55,284	93.85***	805,636	73,287	60.37***	333,532	138,733	3.74*
Assets per WP	263.1	137.1	33.59***	265.1	153.3	12.07***	219.9	221.3	0.28
Total	131	907		148	973		116	692	

Notes:
* = significant at 10%; ** = significant at 5%; *** = significant at 1%.
[a] This test is a comparison between the groups of companies that have made an acquisition during the years 1997-1998, and those that have not made an acquisition during these years.
[b] This test is a comparison between the groups of companies that have made an acquisition during the years 1999-2000, and those that have not made an acquisition during these years.
[c] This test is a comparison between the groups of companies that have made an acquisition during the years 2001-2002, and those that have not made an acquisition during these years.

Table 12 shows that on average acquiring companies are larger than non acquiring companies. This can be explained by the fact that only large companies have the resources and the knowledge that are needed to do an acquisition and therefore are more likely to acquire another company. The fact that acquiring companies are larger than non-acquiring explains that innovation expenditures, value added, and assets of acquiring companies are higher than those of non-acquiring. The fact that firm that make an acquisition have an higher productivity than non-acquiring firms is consistent with Sorensen (2000). However, it is interesting to note that acquiring companies have smaller innovation intensity (inn exp/turnover) than companies that do not follow an acquisition strategy. This can be explained by the fact that firms may substitute innovation for acquisitions, as argued by Hitt, Hoskisson, and Johnson (1990). Another reason can be that acquisitions influence in general the innovation performance of companies (Hitt et al, 1991). This study does not take any knowledge characteristics of the companies into account and therefore it likely that these differences can be found. Despite the fact that the innovation intensity of acquiring firms is lower than those that do not, acquiring firms outperform non-acquiring firms and have higher assets per employed person. The companies that are in this sample experience increasing return to scale.

When the three samples are compared with each other, the characteristics of the third sample differ from the first two. Not only in the number of cases, but also the innovation expenditures averages do not vary from one another, and where the other samples show a significant difference between both assets and assets per employed person, the third sample does not show this. In the third sample the acquiring companies are smaller on average than the first two samples, and the non acquiring companies are on average larger. This indicates that in the third sample the large companies are not as much represented as in the first two. The fact still remains that the percentage of acquiring

companies is the highest in the third sample. It could mean that several large companies did not have made any acquisitions and the smaller companies have made one or more.

4.6 Conclusion Methodology and Data

When compared to previously studies, the methodology and data that are used in this research have several aspects that are new. The most important aspects are the conceptual model that is created, the use of the new data sources like the DYNAMO-Program, the aggregation of CIS data, and the combination of the different data sources to create three datasets that can be used for analysis.

The created model has as dependent variable the productivity growth from t-2 to t. The independent variables are size, capital, innovation intensity, productivity in t-2, and include a vector of firm characteristics like industry classification, technology push and demand pull dummies.

There are differences in the level of identification between the data sources that are used, CIS, SFO, and DYNAMO. Whereas DYNAMO and SFO are collected at company level, is the CIS collected at business unit level. The aggregation procedure that is executed to get the CIS at company level is based on Diederen et al (2005). Nevertheless, the descriptive statistics of the procedure point at some issues that could be a problem. This research makes the assumption that these problems are not relevant.

This study is the first to use parts of the DYNAMO-Program in an analysis. The DYNAMO-Program is a new methodology that describes the dynamics of companies, which is the highest level of microeconomic data. This makes new analysis possible that can shed light on the influence of the dynamic behavior of companies on their performance.

The analysis is done for three periods with three different datasets. These datasets represent the periods 1996-1998, 1998-2000, and 2000-2002. Within these samples the four sectors with the most companies are metals, wood, machinery & equipment, and food. These four sectors have the most companies that acquire a firm in the years t-1 and t. When the means of the variables of companies that have made one or more acquisitions are compared with the means of companies that have not it becomes clear that acquiring companies are larger than non-acquiring companies and as they are larger they also have higher innovation expenditures, value added and assets. Interesting is that acquiring companies have lower innovation intensity than non-acquiring. This could indicate that acquisition is a substitute for innovation. Acquiring companies do, however, have a higher productivity and higher capital per person.

5. Results

5.1 Introduction

The previous chapter has described the methodology and data used in this research. This chapter answers the main question:

What is the influence of acquisitions on the productivity growth of companies in Dutch manufacturing?

To answer this question nine models that distributed over the three periods, 1996-1998, 1998-2000, and 2000-2002, are estimated. For each period, first a restricted model is estimated, and then two full models that include the acquisition variables separately and one that includes them both. The empirical results of the models are displayed and explained in detail in the following paragraph. The results are compared to the expected theoretical signs and to previous findings.

5.2 Empirical results

The estimation results of the study are reported in Table 13, Table 14, and Table 15. There are three periods for which the influence of acquisitions on the productivity growth is estimated. Per period, another dataset is used; the descriptive statistics for these datasets are presented in the previous chapter. For each period four models are estimated, which results in a total of twelve models. In Table 13, the first three models (1-4) relate to productivity growth over the period 1996-1998, in Table 14 the second four (5-8) to productivity growth over 1998-2000, and in Table 15 the final four (9-12) to productivity growth over 2000-2002.

The model specified in equation (1) is estimated by first examining a restricted model and then by extending them to a full model. The restricted model is estimated without any acquisition variables. This makes it possible to see how the estimated coefficients contribute to the overall explanation of the regression and whether or not these coefficients are stable. The models (1), (5), and (9) represent the restricted models. When the coefficients of the restricted models are surveyed it becomes clear that they are stable. The sign of the coefficients does not change when different periods and different datasets are analyzed. For all the periods, the constant is positive and significant, the same accounts for the variables physical capital per employed person, and size/employment. The variable innovation intensity is positive for all the three periods, but is only significant for the first and the last period. The sign of the variable labor productivity (t-2) is in the three periods for the restricted models negative and significant. The variables technologies push and demand pull are non-significant for the three periods.

After the estimation with the basic models, the model is expanded with the addition of a variable that measures the acquisition activity. The expansions are made with two acquisition variables that each measures the acquisition activity at a different time. For each period the model is estimated with the acquisition variables separate and together. Both variables measure the acquisition activity at a later date than the start year, t-2. This approach is chosen because this way, the acquisition variables can not influence the control variables of the restricted model. The R^2 of the full models are higher than the R^2 of the restricted models and between the full models the R^2 stays relatively constant. This is a first indication that the model is stable. Below a more detailed explanation of the differences between the R^2 of the models is provided.

The first acquisition variable that is added to the restricted model is a variable that describes the acquisition activity of the companies in the year t-1. For the period 1996-1998 this is 1997, for 1998-2000 it is 1999, and for 2000-2002 it is 2001. The models (2), (5), and (8) are the full models that are expanded with the acquisition variable at t-1. The signs of the coefficients of the first full models are stable and consistent. For the three

periods, the constant is positive and significant, so are the variables for physical capital per employed person, and size/employment. The variable innovation intensity is positive for the three periods, but is only significant for the first and the last period. The sign of the variable labor productivity (t-2) is in the three periods negative and significant for the full models (2), (6), and (10). The variables technologies push and demand pull are non-significant for the three periods. The variable acquisition intensity at t-1, which is added, compared to the restricted model is negative and significant for the first and the last period, and negative and non-significant for the middle period. The signs and the degree of significance of the coefficients of restricted models (1), (5), and (8) are the same as those of the models (2), (6), and (10). This indicates that the addition of the first acquisition variable does not influence the role of the variables of the restricted model.

Table 13: Regression results for productivity growth 1996-1998

	Productivity Growth 1996-1998			
	(1)	**(2)**	**(3)**	**(4)**
Constant	6.3488*** (0.5095)	6.2572*** (0.5074)	6.3487*** (0.5084)	1.5086*** (0.1820)
Physical Capital per employed person	0.1395*** (0.0406)	0.1505*** (0.0405)	0.1379*** (0.0405)	0.1488*** (0.0404)
Size/Employment	0.0730*** (0.0180)	0.0745*** (0.0179)	0.0709*** (0.0180)	0.0724*** (0.0179)
Innovation intensity	0.4302* (0.2601)	0.4306* (0.2587)	0.4430* (0.2596)	0.4431* (0.2582)
Labor Productivity (t-2)	-0.6932*** (0.0551)	-0.6890*** (0.0548)	-0.6917*** (0.0550)	-0,6876*** (0.0547)
Technology Push Dummy	-0.0279 (0.0536)	-0.0223 (0.0533)	-0.0395 (0.0537)	-0.0337 (0.0535)
Demand Pull Dummy	0.0006 (0.0501)	0.0030 (0.0498)	-0.0001 (0.0500)	0.0023 (0.0497)
Acquisition activity (t-1)		-1.5436*** (0.4399)		-1.5257*** (0391)
Acquisition activity (t)			0.9002** (0.3824)	0.8768** (0.3805)
Industry Dummies	Yes	Yes	Yes	Yes
R^2	0.219	0.228	0.223	0.232
No. of observations	1,038	1,038	1,038	1,038

The second acquisition variable that is added measures the acquisition activity at the final year of the chosen periods, the year t. For the period 1996-1998 this is 1998, for 1998-2000 it is 2000, and for 2000-2002 it is 2002. The models (3), (7), and (11) are the second full models that are expanded with the acquisition variable at t-1. The sign of the coefficients of the second full models are stable and consistent for the three periods. The constant is positive and significant, so are the variables physical capital per employed person, and size/employment. The variable innovation intensity is positive for the three periods, but is only significant for the first and the last period. The sign of the variable labor productivity (t-2) is in the three periods negative and significant for the full models (3), (7), and (11). The variables technologies push and demand pull are non-significant for the three periods. The added variable acquisition intensity at t is positive and significant for the first and the last period, and positive but non-significant for the middle. The sign and the degree of significance of the coefficients of restricted models (1), (5), and (9) are the same as those of the models (3), (7), and (11). This indicates that the addition of the first acquisition variable does not influence the role of the variables of the restricted model.

Finally, the two acquisition variables are added together to the estimation models. The results of this step are shown in the models (4), (8), and (12). When the two variables related and are added to the model it could happen that the sign of the coefficients changes. The sign and degree of significance of the coefficients of the models the (4), (8), and (12) are the same as those of the models with only a single acquisition variable. This indicates that there are no correlation problems among the acquisition variables.

It becomes clear that the models are stable when the signs and degree of significance of the coefficients of the restricted models are compared with the signs and degree of significance of the full models. However, the second period stands out, compared to the first and the last period. In this period the variables innovation intensity and the two acquisition variables are not significant. In the other two periods these variables are significant. This difference can be explained by the fact the structure of an industry, including the number and size of firms, is a function of factors such as technology, government policy, and demand and supply conditions. Major changes, or shocks, in any of these factors can influence the industry structure (Mitchell & Mulherin, 1996). In the period 1998-2000 the internet bubble was at its peek. This means that the productivity growth was probably already high, and that acquisitions and innovation were not important means to realize productivity growth. Another aspect that could have influenced these figures is the fact that an important change in the anti-trust regulation was introduced in the Netherlands at January 1, 1998.

Within the three periods the sign and degree of significance coefficients are consistent, which is evidence for a stable model. Between the models (1), (2), (3), and (4) for the period 1996-1998 are the signs consistent; the same accounts for the models (5), (6), (7), and (8) for the period 1998-2000, and the models (9), (10), (11), (12) for the period 2000-2002.

Table 14: Regression results for productivity growth 1998-2000

	Productivity Growth 1998-2000			
	(5)	**(6)**	**(7)**	**(8)**
Constant	1.0838*** (0.1436)	1.0770*** (0.1441)	1.0927*** (0.1438)	1.0852*** (0.1442)
Physical Capital per employed person	0.0664** (0.0294)	0.0678** (0.0295)	0.0660** (0.0294)	0.0677** (0.0295)
Size/Employment	0.0562*** (0.0138)	0.0566*** (0.0138)	0.0546*** (0.0139)	0.0549*** (0.0139)
Innovation intensity	0.3871 (0.3333)	0.3852 (0.3334)	0.3962 (0.3333)	0.3944 (0.3334)
Labor Productivity (t-2)	-0.4597*** (0.0375)	-0.4597*** (0.0375)	-0.4608*** (0.0375)	-0.4609*** (0.0375)
Technology Push Dummy	-0.0455 (0.0484)	-0.0461 (0.0484)	-0.0438 (0.0484)	-0.0444 (0.0484)
Demand Pull Dummy	0.0515 (0.0416)	0.0516 (0.0416)	0.0493 (0.0416)	0.0493 (0.0416)
Acquisition activity (t-1)		-0.2204 (0.3340)		-0.2583 (0.3352)
Acquisition activity (t)			0.4417 (0.3591)	0.4660 (0.3605)
Industry Dummies	Yes	Yes	Yes	Yes
R^2	0.157	0.157	0.158	0.159
No. of observations	1,121	1,121	1,121	1,121

The R^2 of the basic model can be compared with the other two models in order to determine whether the addition of an extra variable improves the explanatory power of the model. In the first period, 1996-1998, the R^2 of the full models, (2), (3), and (4), is higher than the R^2 of the restricted model, (1). For the second period, 1998-2000, the R^2 of the full models, (6), (7) and (8), does not increase much when compared to the restricted model (5). For the last period, 2000-2002, the R^2 of the full models, (10), (11), and (12), is higher than that of the restricted model, (9). So in the first and the last period the R^2 of the full models is higher than the R^2 of the restricted models. This is not the case for the middle period. The fact that an improvement of the R^2 can be found in two of the three periods, provides an indication that the addition of acquisition variables to the restricted models improves the explanatory power of the model.

When the signs of the variables of the twelve models are compared to the expected theoretical signs it becomes clear that these results show many similarities. The variables physical capital per employed person, size, innovation intensity and demand pull are expected to be positive. The estimation results show that physical capital per employed person, and size are positive and significant for all models. Innovation intensity is positive and significant for the first and last period and non-significant for the middle. Demand pull is non-significant for the three periods. The variables labor productivity at t-2, technology push, and the acquisition activity at t-1 are expected to be negative. Only the variable labor productivity is negative and significant for all three periods. The variable technology push is non-significant in all models. The variable acquisition activity at t-1 is negative and significant for the first and the last period, but non-significant for the middle period. The variable acquisition activity at t is expected to be either positive or negative. The estimation results have shown that it is positive for the period 1996-1998 and 2000-2002 and non-significant for the period 1998-2000.

Table 15: Regression results for productivity growth 2000-2002

	Productivity Growth 2000-2002			
	(9)	**(10)**	**(11)**	**(12)**
Constant	1.6179*** (0.2077)	1.6160*** (0.2072)	1.6468*** (0.2079)	1.6451*** (0.2074)
Physical Capital per employed person	0.1076** (0.0421)	0.1060** (0.0421)	0.1064** (0.0421)	0.1047** (0.0420)
Size/Employment	0.0357** (0.0177)	0.0356** (0.0177)	0.0336** (0.0177)	0.0334* (0.0177)
Innovation intensity	0.6577** (0.2766)	0.6502** (0.2759)	0.6489** (0.2761)	0.6412** (0.2755)
Labor Productivity (t-2)	-0.6453*** (0.0525)	-0.6408*** (0.0524)	-0.6487*** (0.0524)	-0.6442*** (0.0523)
Technology Push Dummy	0.0158 (0.0589)	0.0101 (0.0588)	0.0158 (0.0588)	0.01001 (0.0587)
Demand Pull Dummy	0.0005 (0.0677)	0.0071 (0.0676)	-0.0049 (0.0676)	0.0017 (0.0675)
Acquisition activity (t-1)		-0.5766** (0.2598)		-0.5805** (0.2594)
Acquisition activity (t)			0.7874* (0.4097)	0.7945* (0.4087)
Industry Dummies	Yes	Yes	Yes	Yes
R^2	0.218	0.223	0.222	0.223
No. of observations	808	808	808	808

The sing of the coefficients can also be used to find what the influence is of the variables on the productivity growth of companies. The sign of the coefficient of the variable capital is positive. This indicates that the amount of capital that an employed person has to his disposal has a positive influence on the productivity growth of companies. This is logical as capital is one of the production factors in the Cobb-Douglas function.

The variable size also has a positive value; from this positive value can be derived that there are increasing returns to scale in these samples. The more employed persons a company has in t-2, the larger the productivity growth over t-2 to t will be. This means that in these three datasets the larger companies have an advantage over small companies.

Innovation intensity is positive for two out of three periods. Innovation intensity is an input variable and one of the main disadvantages of the use of an innovation input variable is that there is a high degree of uncertainty whether or not innovation input leads to innovation output (Kleinknecht, 2002). It is the innovation output that gives companies the innovative advantage over other companies. However, the higher the innovation intensity is the more likely it is t hat a company will bring a new or improved product on the market and will receive above average profits from that. This is likely the reasons that higher the

percentage of innovation expenditures on the total turnover of the company in t-2, the higher the productivity growth over t-2 to t.

The value of the lagged labor productivity is negative, as is expected. It has a significant negative influence on the productivity growth in over t-2 to t. The coefficients in the first period are on average 0.69, those of the second period are 0.46, and of the last they are 0.65. This means that, for the first period, firms with a higher productivity level in 1998 are only able to maintain 31% of productivity in 1996. For the second period, firms with a higher productivity level in 2000 are only able to maintain 54% of productivity in 1998. In the last period, firms with a higher productivity level in 2002 are only able to maintain 35% of productivity in 2000.

As both the technology push and the demand pull dummy are not significant it seems to be that they do not influence the productivity growth of the companies of this sample. This corresponds with findings by Belderbos (2004).

The most interesting aspect of the results are the outcomes of the acquisition variables; the variable that measures acquisition at t-1 shows a negative sign and the variable that measures acquisition at t shows a positive sign. Both the variables are significant for the periods 1996-1998 and 2000-2002; the period 1998-2000 shows no significant results. These results show that despite the fact that on the short term acquisitions positively influence the performance of companies; this positive effect becomes negative over the longer term.[18] This can be explained by the fact that a company most of the time will make an acquisition if they think that the performance of the target firm can be easily improved; in other words that the target firm is underperforming. During the acquisition process non-performing parts can easily be cut away and only the well performing parts of the acquiring company remain. Via this process the performance of both the acquiring and target firm can be improved. However, on the long term several other processes take place. As is describe in the literature chapter there are several bottlenecks in the implementation process of an acquisition. These bottlenecks could influence the productivity of the acquiring company negatively if not dealt with. The problems are for instance that companies make the mistake of not appreciating that an acquisition may require as much, or indeed greater, change on their part as for the acquired company (James et al., 1998). Another aspect is that both the acquiring as the target firm needs to be in a certain state of fluidity in order to smooth the implementation process. The more fluid the firms are the more likely it is that the implementing of a target firm is done without any problems (Hitt et al., 1998). During the acquisition process it is likely that that the focus of firms shifts from a focus on strategic controls towards financial controls (Hitt et al., 1996). This will results in a more short term based strategy and will make profits on the short term but the focus will turn away form long term processes like innovation. Therefore the long term performance will suffer from the acquisitions made by the acquiring firm. An aspect that comes from the theories that have a innovation background is that acquisitions disrupt the internal processes in a company and thus the innovative performance. The managerial commitment will be drawn towards the implementation of the acquisition and is therefore not longer aimed at, for instance, innovation process (Ahuja & Katila, 2001). As these processes receive less attention they are not likely to influence the productivity in a positive way and therefore the productivity will be negatively influenced.

5.3 Conclusion

The signs and coefficients of the nine estimated models indicate that the used model is stable as they consistent, within the three periods and between the three periods. There are a few exceptions, like innovation intensity and the acquisition variables. The results of both variables in the second period differ from those in the first and the last. Within the second period the results are consistent.

[18] Short term and long term is relative. In this study a relative short time span is analysed. It is acknowledged that acquisitions are bound to have an influence on the productivity growth of companies that lasts longer than a two year period. Further research should be done to study the more long term influence.

For the first and the last period, the explanatory value of the models improves when the acquisition variables are added. This indicates that acquisitions influence the productivity growth of companies.

The results also show that the amount of capital per employed person positively influence the productivity growth of companies. Furthermore, the companies in the three datasets experience increasing returns to scale. Innovation intensity also positively influences the productivity growth of companies. The lagged productivity influences the productivity growth negatively; the companies with a higher productivity in t are able to maintain as low as 31% and as high as 54% of the productivity in t -2 for the three periods.

The results of the acquisition variables are interesting. The coefficient of the acquisition variable that measures the acquisition activity at t-1 is significant and has a negative sign for the first and the last period. The coefficient of the acquisition variable that measures the acquisition activity at t is also significant and has a positive sign for the same periods. These results can be interpreted the following: acquisitions have a positive effect on the short term, but negatively influence the productivity growth of the acquiring companies on the long term. The differentiation between the influence at different points in time is a new finding. This could explain why an active acquisition strategy is still a very popular expansion method of companies. The short term success will enforce the believe that the decision to acquire has been the right one.

6. Conclusion and Discussion

This chapter describes the most important conclusions that can be drawn from this research, and it provides a discussion on the research that is combined with recommendations for further research.

6.1 Conclusions

The discussion on the relation between mergers and acquisition and the performance of companies show contradiction results. Some studies have found that acquisitions have a positive influence on performance, whereas others have found a negative relation. Due to the lack of consensus in this field of study is the main objective of this research to shed light on the influence of acquisitions on the productivity growth of Dutch companies. The accompanying main question is:

What is the influence of acquisitions on the productivity growth of companies in Dutch manufacturing?

The statistical model that answers this question is estimated with the use of three datasets, each dataset represents a period, the first 1996-1998, the second 1998-2000, and the last 2000-2002. Each dataset is created by combining three data sources from Statistics Netherlands: DYNAMO, CIS, and SFO. For each period three models are estimated, first a restricted model, without acquisition, and then two full models that include acquisition variables.

From the results of the estimation it can be concluded that the model that is created is stable, as the coefficients and signs are consistent for the three periods. Furthermore, it turns out that the amount of capital per employed person positively influences the productivity growth of companies. In addition, the companies in the three datasets experience increasing returns to scale. Innovation intensity also positively influences the productivity growth of companies. The lagged productivity influences the productivity growth negatively.

The results of the acquisition variables are interesting. The coefficient of the acquisition variable that measures the acquisition activity at t-1 is significant and has a negative sign for the first and the last period. The coefficient of the acquisition variable that measures the acquisition activity at t is also significant and has a positive sign for the same periods. These results can be interpreted the following: acquisitions have a positive effect on the short term, but negatively influence the productivity growth of the acquiring companies on the longer term. The differentiation between the influences at different points in time is a new finding. This could explain why an active acquisition strategy is still a very popular expansion method of companies. The short term success will enforce the believe that the decision to acquire has been the right one.

This study contributes to the discussion on the influence of acquisition on the performance through several aspects. First it is one of the first to use the growth in productivity to measure the performance of companies. Second, it utilizes a new methodology to measure the acquisition activity of firms at headquarter level. Third, it is one of the first studies to employ aggregated CIS data. Fourth and finally, it sheds light on the relation between acquisitions and performance of Dutch firms.

6.2 Discussion and further research

There are several points of discussion that somewhat limit the finding of this study. The most important is the problem with the aggregation step of CIS data. As this data is collected at business unit level, it needs to be aggregated to company level. However, not all business units that belong to a company are part of the CIS sample which could lead to an underestimation of the innovation data. Even though this research assumes that this

underestimation does not influence the outcomes of this study, it is necessary to realize that this problem could influence the outcomes. Further research should be done to analyze the influence of this problem on estimation results.

Another aspect that limits the study is the measurement of performance. Despite the fact that productivity growth is one of the most important indicators for performance it would interesting to compare the results of this study to other measurements of performance, like innovative performance.

This study shows that there are differences in the influence of acquisitions on the productivity growth of companies when the acquisitions are analyzed at a different point in time. This research only studies the relative short time span of two years. For further research it is interesting to expand this period and measure the influence of acquisitions for a much longer period of time.

Further research should also try to extend the economic sectors that are studied. It would be interesting to compare the results of manufacturing to those of services.

Another limitation of this study is caused by the way data should be collected by the European members. To prevent double measurement, each member only collects information on the economic activities that take place in its own country. However, this means that there is no data available for an entire multination company. It would be very interesting to do a pan-European analysis for multinational companies that include all the business units/enterprises that are owned by the company.

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8. Appendices

Appendix 1: The Dutch standard industry classification 1993

Industry	SBI Code	Industry Definition
Food	15-16	Manufacture of food beverages and tobacco.
Textile	17-19	Manufacture of textiles, wearing apparel dressing and dyeing of fur, tanning and dressing of leather, luggage, handbags, saddlery, harness, and footwear.
Wood	20-22	Manufacture of wood, products of wood and cork, manufacture of straw and plaiting materials, pulp, paper and paper products, publishing, printing, and reproduction of recorded media.
Chemicals	23-24	Manufacture of coke, refined petroleum products and nuclear fuel, manufacture of chemicals and chemical products.
Plastic	25	Manufacture of rubber and plastic products.
Non-Metallic	26	Manufacture of other non-metallic mineral products.
Metals	27-28	Manufacture of basic metals, fabricated metal products, except machinery and equipment.
M&E	29	Manufacture of machinery and equipment not elsewhere classified.
Electrical	30-33	Manufacture of office machinery and computers, electrical machinery and apparatus, radio, television and communication equipment and apparatus, medical precision and optical instruments, watches and clocks.
Vehicle	34-35	Manufacture of motor vehicles, trailers, semi trailers, and other transport equipment.
NEC	36-37	Manufacture of furniture and not elsewhere classified.

Appendix 2: Cross tab with number of BEs per OND in DYNAMO 1996 and CIS 20

		Number of BEs in CIS 20												
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**13**	**14**	**25**	**Total**
Numbe of BEs per OND in DYNAMO 1996	**1**	403	0	0	0	0	0	0	0	0	0	0	0	403
	2	224	29	0	0	0	0	0	0	0	0	0	0	253
	3	103	17	8	0	0	0	0	0	0	0	0	0	128
	4	44	16	3	1	0	0	0	0	0	0	0	0	64
	5	43	7	2	1	1	0	0	0	0	0	0	0	54
	6	15	4	5	0	0	0	0	0	0	0	0	0	24
	7	12	4	1	0	0	0	0	0	0	0	0	0	17
	8	6	3	1	0	2	1	0	0	0	0	0	0	13
	9	8	4	2	0	1	0	0	0	0	0	0	0	15
	10	8	1	1	1	1	1	0	0	0	0	0	0	13
	11	5	1	0	0	0	0	0	0	0	0	0	0	6
	12	3	0	0	0	0	1	1	1	0	0	0	0	6
	13	2	3	0	2	0	0	0	0	0	0	0	0	7
	14	0	1	0	0	1	0	0	0	0	0	0	0	2
	15	2	0	1	0	1	0	0	0	0	0	0	0	4
	16	3	1	0	0	0	0	0	0	0	0	0	0	4
	17	0	0	0	0	1	0	0	0	0	0	0	0	1
	18	1	1	1	0	0	0	0	0	0	0	0	0	3
	19	2	0	0	1	0	0	0	0	0	0	0	0	3
	20	2	0	0	0	0	0	0	0	0	0	0	0	2
	21	1	0	0	0	0	1	0	0	0	0	0	0	2
	23	1	0	0	0	0	0	0	0	0	0	0	0	1
	24	1	0	0	1	0	0	0	0	0	0	0	0	2
	25	0	0	1	0	0	0	0	0	0	0	0	0	1
	26	0	0	0	1	0	0	0	0	1	0	0	0	2
	28	0	0	0	1	0	0	0	0	0	0	1	0	2
	29	1	0	0	0	0	1	0	0	0	0	0	0	2
	34	0	0	0	1	0	0	0	0	0	0	0	0	1
	48	0	0	0	0	0	0	0	0	0	1	0	0	1
	58	0	0	0	0	1	0	0	0	0	0	0	0	1
	77	0	0	0	0	0	0	0	0	0	0	0	1	1
Total		886	92	26	10	9	5	1	1	1	1	1	1	1038

Appendix 3: Cross tab with number of BEs per OND in DYNAMO 1998 and CIS 25

		Number of BEs in CIS 25																	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**18**	**33**	**Total**
Number of BEs per OND in DYNAMO 1998	**1**	610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	610
	2	156	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	175
	3	82	13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97
	4	49	16	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73
	5	18	18	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	38
	6	17	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	35
	7	3	5	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	16
	8	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	13
	9	3	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	8
	10	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	11	0	0	2	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	7
	12	1	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	9
	13	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
	14	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	16	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
	17	0	0	0	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0	6
	18	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	19	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	3
	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	21	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	3
	25	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2
	26	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
	27	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	2
	29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	46	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	51	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	71	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Total		937	93	28	15	15	7	4	3	1	2	1	2	1	1	1	1	1	1	1121

Appendix 4: Cross tab with number of BEs per OND in DYNAMO 2000 and CIS 30

		Number of BEs in CIS 30														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**13**	**19**	**20**	**Total**
Number of BEs per OND in DYNAMO 2000	**1**	430	0	0	0	0	0	0	0	0	0	0	0	0	0	430
	2	105	11	0	0	0	0	0	0	0	0	0	0	0	0	116
	3	70	14	1	0	0	0	0	0	0	0	0	0	0	0	85
	4	33	16	4	0	0	0	0	0	0	0	0	0	0	0	53
	5	18	9	2	1	0	0	0	0	0	0	0	0	0	0	30
	6	6	2	4	0	0	0	0	0	0	0	0	0	0	0	12
	7	9	6	2	1	0	0	0	0	0	0	0	0	0	0	18
	8	2	4	1	1	0	1	0	0	0	0	0	0	0	0	9
	9	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4
	10	1	1	1	0	0	1	0	0	0	0	0	0	0	0	4
	11	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3
	12	0	3	2	1	0	0	1	0	0	0	0	0	0	0	7
	13	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2
	14	1	0	0	1	0	2	0	0	0	0	0	0	0	0	4
	15	1	1	0	1	1	0	0	1	0	0	0	0	0	0	5
	16	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
	17	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
	18	1	0	1	0	0	0	0	1	0	0	0	0	0	0	3
	19	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2
	21	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
	22	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
	23	0	0	3	0	0	0	0	0	1	0	0	0	0	0	4
	24	0	1	0	0	0	0	0	1	0	0	0	1	0	0	3
	32	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	33	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
	40	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	42	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2
	73	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total		673	71	25	13	2	6	2	4	3	1	1	1	1	1	808

Appendix 5: Difference between BE and OND for Technology Push CIS 20

	BE		OND	
	Percentage	**No of observations**	**Percentage**	**No of observations**
Value '1'	24,5	364	30,7	319
Value '0'	63,8	949	69,3	719
Missing value	11,7	174	0,0	0
Total	100,0	1487	100,0	1038

Appendix 6: Difference between BE and OND for Technology Push CIS 25

	BE		OND	
	Percentage	**No of observations**	**Percentage**	**No of observations**
Value '1'	20,7	333	24,4	273
Value '0'	69,0	1112	75,6	848
Missing value	10,4	167	0,0	0
Total	100,0	1612	100,0	1121

Appendix 7: Difference between BE and OND for Technology Push CIS 30

	BE		OND	
	Percentage	**No of observations**	**Percentage**	**No of observations**
Value '1'	31,3	356	38,0	307
Value '0'	58,1	660	62,0	501
Missing value	10,6	120	0,0	0
Total	100,0	1136	100,0	808

Appendix 8: Difference between BE and OND for Demand Pull CIS 20

	BE		OND	
	Percentage	**No of observations**	**Percentage**	**No of observations**
Value '1'	730	49,1	635	61,2
Value '0'	583	39,2	403	38,8
Missing value	174	11,7	0	0,0
Total	1487	100,0	1038	100,0

Appendix 9: Difference between BE and OND for Demand Pull CIS 25

	BE		OND	
	Percentage	**No of observations**	**Percentage**	**No of observations**
Value '1'	764	47,4	624	55,7
Value '0'	681	42,2	497	44,3
Missing value	167	10,4	0	0,0
Total	1612	100,0	1121	100,0

Appendix 10: Difference between BE and OND for Demand Pull CIS 30

	BE		OND	
	Percentage	**No of observations**	**Percentage**	**No of observations**
Value '1'	818	72,0	629	77,8
Value '0'	191	16,8	179	22,2
Missing value	127	11,2	0	0,0
Total	1136	100,0	808	100,0

Appendix 11: Innovation expenditure at BE and OND level CIS 20-25-30

	No of observations	Mean	Std. Deviation
Total innovation expenditures CIS 20 BE	1.313	2.772	36.964
Total innovation expenditures CIS 20 OND	1.038	3.108	39.515
Total innovation expenditures CIS 25 BE	1.445	2.749	29.128
Total innovation expenditures CIS 25 OND	1.121	3.298	33.790
Total innovation expenditures CIS 30 BE	1.136	7.208	91.424
Total innovation expenditures CIS 30 OND	808	9.252	107.298