Radboud University

Firm independence as a driver of product innovation

The impact of firm independence on product innovation by firms in the Dutch manufacturing industry

Master Thesis Business Administration - Strategic Management

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Abstract

Nowadays, many firms use technological acquisitions to access innovations that were generated by other firms. Firms that are acquired generally lose their independence. The question arises if (not having) autonomy has an impact on the level of product innovation in firms. Based on existing theory and empirical evidence, the presumption is made that firm independence is beneficial for product innovation. Since not being independent entails group membership, the impact of group membership on product innovation is also addressed. It is expected that group membership is beneficial for new-to-the-firm innovation, but not for new-to-the-market innovation. In order to test the aforementioned presumptions, a mixed methods research is conducted. The quantitative data come from the 2009 European Manufacturing Survey, whereas the qualitative data consists of three interviews conducted at recently acquired manufacturing firms. The results show that in general, firm independence does not have an impact on the likelihood of firm establishments to introduce product innovations. Furthermore, group membership does not have an impact on the likelihood to introduce NTTF product innovations. Young subsidiaries do appear to perform better in terms of product innovation compared to young stand-alone firms, but overall there is no difference between these firm establishment types. The qualitative data indicate that for firms that were acquired in recent years, there are benefits of losing independence and gaining group membership on their innovation activities. However, because of the quantitative outcomes, this positive effect is thought to be temporary. The thesis finishes with a discussion of the results, theoretical as well as practical implications and limitations of this research. Also, a reflection of the research process is given.

Chapter 1 - Introduction

1.1. Introduction

What makes firms innovative? This question has been the driving force of many studies. The reason behind the desire to find the drivers of innovation in firms is that they can result in a competitive advantage and better performance (Crossan & Apaydin, 2010; Damanpour & Wischnevsky, 2006). Vice versa, firms that do not innovate (enough) have a bigger chance of underperforming. Innovation is therefore of vital importance to firms. It is considered to be one of the key drivers of corporate success (Frambach & Schillewaert, 2002).

Firms can use different types of strategies in their pursuit of innovation. They can try and generate innovations internally, if they possess the necessary resources. Mergers and acquisitions (M&A) can be used to get access to innovations that have been developed by other firms (Cefis & Marsili, 2015). Declining R&D productivity can be a motivation for firms to acquire innovative firms (Higgins & Rodriguez, 2006). In recent years, the innovation-through-acquisition strategy has become very popular among firms (De Man & Duysters, 2005; PwC, 2014). Google is a well-known example of a firm that uses such an innovation strategy. The internet giant has been buying a large number of tech firms, with the objective to use the innovative products and technologies that these firms possess for its own advantage (Luckerson, 2015; D'Onfro, 2015). Famous examples of Google's successful innovation-driven acquisitions are YouTube and Android.

Firms that become part of a corporate group as a result of innovation-driven M&A are no longer independent (Puranam et al., 2006). Could such a loss of autonomy have consequences for the level of innovation within a firm? This question forms the motive for the subject of this thesis: the effect of firm independence on innovation. To date, little is known about the specific relationship between independence and innovation. The inconclusive and sometimes contradictory findings in research on the effect of M&A on innovation – which will be discussed later on – give reason to suspect that certain advantages in terms of innovation might exist for independent firms, when compared to non-independent firms. The aim of this thesis is to help clarify the existing uncertainties regarding the relationship between firm independence and innovation, by providing new empirical evidence on this subject. This relationship will be investigated extensively, first by exploring existing theory and empirical studies, and then by conducting a quantitative and qualitative data analysis.

1.2. Context and perspectives in society

These days many successful innovations originate from small, young and independent firms, commonly referred to as start-ups (KPMG, 2015). Apparently, such firms are able to be successful innovators without being part of a group. The fact that many start-ups are acquired by big firms because of their

innovativeness indicates that these young, independent firms can and regularly do outperform big and established firms in terms of innovation. After all, if big firms had the knowledge and ability to generate the desired innovations themselves, they would not have to acquire these start-ups for their innovation.

In 2009, Dutch energy firm Essent was acquired by RWE, a German energy firm. Prior to the acquisition, Essent was fully owned by Dutch provinces and municipalities. The province of North Brabant, the WWF and the Dutch parliament all had serious concerns about the acquisition, because RWE was far less developed in terms of sustainability than Essent (Trouw, 2009; Jansen, 2009; Van der Hoeven, 2009; ANP, 2009). RWE made promises about investing in sustainable energy so that the acquisition could take place (NRC, 2009). However, since the acquisition, the production of and investments in sustainable energy by Essent have decreased significantly (RTL Z, 2014; Stichting Essent Sustainability Development, 2014). This case illustrates that losing independence after being acquired can have a negative impact on the level of innovation within that firm. There are several examples like the one of Essent that have sparked discussions in society and politics. Here the question arises if and, if so, how governments should act upon such acquisitions, to protect and foster innovation by independent firms.

In recent years, innovation has been an important subject in politics, on a national level as well as on an international level. The Dutch government is actively trying to stimulate innovation, especially within start-ups (Rijksoverheid, 2016; Rijksoverheid, n.d.). The European Union has developed an extensive program to stimulate innovation. The goal is to increase the competitiveness of the EU in the global market, by removing barriers to innovation and by public funding (Rijksdienst voor Ondernemend Nederland, n.d.; European Commission, n.d.; European Parliament, n.d.). Governments are thus actively creating and executing policies to spur innovation.

In 2016, the European Commission blocked the acquisition of British telecom provider O2 by a Chinese conglomerate. The reason for prohibiting this takeover was that it would have hindered competition and as a result harmed innovation in the mobile telecom sector (European Commission, 2016a; European Commission, 2016b). Research suggests that competition can stimulate innovation (Aghion et al., 2001; Gilbert, 2006). This raises the question as to how governments should deal with the sometimes-conflicting forces of competition, M&A and innovation (Katz & Shelanski, 2007). According to former European Commissioner Neelie Kroes, the fact that many start-ups are acquired before they get a chance to grow is a big problem (Kraan, 2013). When a firm becomes a target in a technological acquisition, it usually results in the disappearance of that innovative firm from the market (Szücs, 2014). Should governments promote independence of firms in order to protect and increase their innovation?

Firms that engage in M&A are not the only ones causing start-ups to give up their independence. A significant part of innovative start-ups receives funding from Venture Capital firms (VC firms) (Centraal Planbureau, 2015). In return for their investment, they generally receive shares which they can use to control the start-ups. As a result, the start-ups that receive funding lose their autonomy. Since VC firms

want a return on their investment as quickly as possible and only invest in firms of which they think have sufficient profit potential, this type of investment might not be a good way to stimulate ongoing innovation (Caselli et al., 2009; Hirukawa & Ueda, 2011).

1.3. Context and perspectives in theory

Specific research on the relationship between firm independence and innovation is limited. However, presumptions can also be derived from innovation literature that is (indirectly) related to firm independence. Since being acquired generally entails a loss of independence, the existing literature on M&A and innovation can be useful in this context.

So far, research on the impact of M&A on innovation has provided mixed results (Ensign et al., 2014). On the one hand, research indicates that M&A can have a positive impact on innovation investments made by firms (Cefis, 2010). Since acquisitions can lead to improvements in a firm's technology, acquired firms are more likely to innovate following an acquisition (Guadalupe et al., 2012; Zhao, 2009). They could profit from knowledge that is transferred to them by their acquirer (Sadowski & Sadowski-Rasters, 2006). On the other hand, there is also plenty of research that finds a negative impact of M&A on innovation. M&A can lead to fewer incentives for firms to innovate (Ornaghi, 2009). The innovativeness of acquired firms may decline following an acquisition (Hitt et al., 1991). The post-M&A integration process can consume resources that would otherwise have been used for innovation, and can therefore be harmful for innovation (De Man & Duysters, 2005; Cefis & Marsili, 2015). Furthermore, knowledge transfer from parent firms could reduce the incentive for acquired firms to innovate themselves, because they can get access to existing technology instead of having to generate it on their own (Stiebale & Reize, 2011). Thus, M&A literature does not give a decisive answer on what the effect of losing autonomy is on the level of innovation within a firm.

Stand-alone firms are independent, but do not belong to a group. As such, they cannot enjoy the possible innovation-related benefits of group membership. However, the inconsistent results of M&A research lead to the expectation that certain innovation advantages might exist for independent firms compared to non-independent firms. Not having autonomy (as a result of being acquired) can lead to a decrease in the likelihood of a firm introducing new products (Puranam et al., 2006). The integration process after losing independence can be disruptive for continued innovation in acquired firms (Puranam & Srikanth, 2007). This might explain (some of) the conflicting results of M&A research when it comes to innovation. The aforementioned studies also indicate that group membership, as a consequence of losing autonomy, does not necessarily lead to better innovation performance.

Some scholars argue that combining knowledge from the acquiring firm and acquired firm can have a positive impact on innovation (Ahuja & Katila, 2001). As such, group membership might (partially) counteract the negative impact of not having autonomy in acquired firms. When it comes to the possible

innovation-related benefits of group membership and independence, the effect on introducing innovations that are new to the market can be different from the effect on introducing innovations that are only new to the firm. This is because the generation of innovations that are new to the market requires different skills and is affected by other factors than the introduction of already existing innovations (Sadowski & Sadowski-Rasters, 2006). Previous research has shown that group membership has a positive effect on new-to-the-firm innovation, but has no impact on new-to-the-market innovation (Sadowski & Sadowski-Rasters, 2006; Frenz & Ietto-Gillies, 2007). The reason for this difference appears to be the fact that new-to-the-firm innovations can be the direct result of knowledge transfer, whereas new-to-the-market innovations cannot. Since not being independent entails group membership, the impact of independence might also be different for new-to-the-firm innovations than for new-to-the-market innovations.

When young firms (i.e. start-ups) lose their independence, the impact on their innovation might be different than when older, more established firms lose their independence. Existing research shows that the negative effect of losing autonomy is bigger for firms that have not yet introduced innovations than for firms that have already introduced innovations. This is because the activities related to introducing the first innovation(s) are affected more by not being independent than the activities related to introducing later innovations (Puranam et al., 2006). As such, the youthfulness of a firm establishment might affect the relationship between firm independence and innovation.

1.4. Objective and research question

The main objective of this thesis is to contribute to the existing literature on innovation at the firm level, by investigating what effect the independence of a firm has on the level of innovation within that firm. Since research on the relationship between independence and innovation is very limited, this thesis aims to make a valuable contribution to the existing literature. Also, since most research on innovation and M&A has been done using only data from large firms, another goal is to see if the presumptions from the existing body of innovation research will hold when firms of varying sizes are investigated.

From a more practical perspective, the objective of this thesis is to generate knowledge which firms can make use of, in pursuit of increasing and improving their innovation. The aim is that this knowledge can help firms to choose the optimal innovation policy by deciding upon the independence of themselves, their subsidiaries or M&A targets. Furthermore, governments can use the outcome of this research with regard to creating and executing innovation-stimulating policies and other measures. It could also help them to decide whether the acquisition of innovative (start-up) firms is something to stimulate or something they should discourage.

The introduction of new products is considered as the most important indicator of innovation success in firms (Puranam et al., 2006). Since the aim is to discover the effect of firm independence on the innovative performance of firms, this thesis will focus on product innovation.

In this thesis, three types of firm establishments will be identified: stand-alone firms, headquarters (HQ), and subsidiaries. The reason for this distinction is that the independence of a firm does not give information on the possible group membership of that firm, and vice versa. After all, an independent firm can be either a group firm (HQ) or a non-group firm (stand-alone), whilst a group firm can be either independent (HQ) or non-independent (subsidiary). The division of firm establishments into three types makes it possible to make a clear distinction between the impact of independence on innovation on the one hand, and the impact of group membership on innovation on the other hand.

In conclusion, this thesis aims to answer the following main research question:

What is the effect of firm independence on product innovation in firm establishments?

From this main question and the theory addressed above, the following sub-questions can be derived:

1. *What is the effect of firm independence on new-to-the-market product innovation in firm establishments?*
2. *What is the effect of firm independence on new-to-the-firm product innovation in firm establishments?*
3. *What is the effect of group membership on new-to-the-firm product innovation in firm establishments?*
4. *What is the effect of group membership on new-to-the-market product innovation in firm establishments?*
5. *Is the effect of firm independence on (new-to-the-firm and new-to-the-market) product innovation different for younger firms than for older firms?*

1.5. Scientific and practical relevance

In terms of scientific relevance, this thesis will contribute to the existing literature on innovation from a new angle, namely by looking specifically at the independence of firms and its relationship to innovation. To date, this angle appears to have been underexposed in theory. An insight in possible effects of independence on innovation will be valuable information for scholars, in part because it is related to the relationship between M&A and innovation. Existing research does not consider the concepts of autonomy and group membership simultaneously. In this thesis however, both concepts are addressed, which makes it possible to determine the effects of independence and/or group membership for HQ firms, subsidiaries and stand-alone firms. This thesis looks at the impact of losing independence, but also at the general effect of (not) being independent on innovation. This could shed more light on

the sustainability of these effects on innovation. Unlike most previous studies, this thesis takes into account the age of a firm establishment. This way, the role of age in the relationship between firm independence and innovation can be investigated. Younger firms might react differently to (not) being independent than older firms. To date, most literature on innovation and M&A has focused on large MNEs, creating a one-sided view on the subject (Cefis & Marsili, 2015). Research outcomes might be different for smaller firms and/or domestic firms. Therefore, new evidence from different sizes of firms and from both multinational and domestic firms is a valuable contribution to the existing body of theoretical and empirical knowledge on this subject. This thesis also aims to take away some of the inconsistencies and contradictions in M&A research. Since being acquired entails a loss of independence, knowing the effect of independence on innovation might be of good use when trying to explain the impact of M&A on innovation.

This research is practically relevant for the following reasons. The results of a comparison between independent firms and non-independent in terms of the level of innovation could help group firms to determine the best strategy for improving innovation within their subsidiaries. For example, if it turns out that independent firms perform better in terms of innovation, giving more autonomy to subsidiaries might be beneficial for innovation. Furthermore, it could help in making decisions concerning innovation-driven M&A strategies. If independent firms are found to be better innovators, buying such firms for their innovativeness and thereby taking away their independence might not be the best move in the long run for both parties. After all, acquired firms would lose their innovativeness for which they were originally acquired. Instead of using acquisitions, firms could look for other ways to access other firms' innovations. On the other hand, the outcomes of this research could help independent firms in their consideration to either become part of a group or stay autonomous, when deciding on the best innovation strategy for their firm. Finally, governments should decide upon the best policy for stimulating innovation in firms. Should the independence of firms be encouraged, or is it better for innovation if firms get acquired? Such insights can be useful for selecting the optimal governmental policy regarding innovation.

1.6. Outline of thesis

This thesis will continue as follows. In Chapter 2, relevant existing theory and empirical studies will be reviewed, key concepts will be identified, relationships between these concepts will be discussed and a conceptual framework will be presented. In Chapter 3, the data and methodology of the quantitative and qualitative analyses will be discussed. Chapter 4 will elaborate on the results that have been found. In Chapter 5, the results are discussed and based upon the results relevant conclusions will be drawn. This chapter will also give some practical implications and further recommendations, as well as a reflection upon the process of writing this thesis.

Chapter 2 – Theoretical Framework

2.1. Introduction

This chapter will give an overview of the current body of theoretical knowledge regarding innovation, firm independence and the relationship between these concepts. In paragraph 2.2, the key concepts of this research will be defined and explained. In paragraph 2.3, the relationships between these concepts will be described. This is done by using the relevant theories and perspectives regarding the identified concepts and relationships. Paragraph 2.3.1 addresses the theoretical views on the relationship between the key concepts, whereas paragraph 2.3.2 looks at existing empirical evidence regarding that relationship. Paragraph 2.3.3 discusses the influence of firm youthfulness on the relationship between independence and innovation. In paragraph 2.3.4, the difference between new-to-the-market and new-to-the-firm innovation is addressed. Paragraphs 2.3.2 through 2.3.4 also contain the hypotheses, which are formulated based on the findings from both theory and empirical studies. In paragraph 2.4, a conceptual model is drawn up based on these hypotheses.

2.2. Definition of key concepts

In the previous chapter, the subject of this thesis was introduced: the effect of firm independence on product innovation. This paragraph will define and elaborate on the key concepts of this thesis and describe how these concepts are framed in the literature. The concepts that will be addressed here are innovation and firm independence. These key concepts will be used when formulating hypotheses and constructing a conceptual framework.

2.2.1. Innovation

The first key concept of this research is that of innovation. In order to make statements about the effect of independence on innovation in firms, the question of what is meant by the concept of innovation in the literature and in this thesis should be elaborated on first.

Since many different types of innovation are distinguished in the literature, a single definition of innovation is inevitably quite broad. Even though definitions of innovation vary across studies, there appears to be some level of general agreement in theory on what is understood by this term. As a general definition, innovation is the development and/or the use of new ideas or new behaviors in firms (Damanpour & Wischnevsky, 2006). An innovation is always something new; it can be a product, a service, a production method, an organizational structure, an administrative system, a plan or a program (Crossan & Apaydin, 2010; Damanpour, 1991). Such new ideas or behaviors can be generated by the organization itself, but the adoption of something new that has been created by others can also be considered an innovation to the adopting organization (Crossan & Apaydin, 2010; Damanpour & Wischnevsky, 2006). In order for a new idea or behavior to be regarded as an innovation, it has to be

implemented by the organization (Damanpour 1991). Thus, if something new is invented but not implemented, it is not an innovation.

As stated above, innovation comes in many forms and numerous distinctions have been made by scholars. The reason behind the development of these distinctions is that past research on innovation as one general concept provided inconsistent results (Damanpour & Wischnevsky, 2006). The relevant distinctions will be discussed below.

First of all, a division can be made between the adoption and the diffusion of innovation (Damanpour, 1991). The adoption of an innovation entails the decision of a firm to make use of an innovation, whereas diffusion of innovation refers to the accumulated level of users of an innovation in a certain market (Frambach & Schillewaert, 2002). Thus, adoption takes place at the firm level, whereas diffusion occurs at the market level. This thesis focuses on the adoption of innovations, since the effect of independence on innovation will be studied at the firm (establishment) level. After all, the central question is how independence of individual firms affects their innovation.

A distinction can also be made between innovation as an outcome and innovation as a process. Innovation as a process precedes innovation as an outcome. Innovation as a process itself is not sufficient for innovation (Crossan & Apaydin, 2010). Innovation as an outcome is usually a key dependent variable in innovation research, since the main focus of scholars often lies on the outcome rather than the process of innovation activities (Crossan & Apaydin, 2010). In this thesis, only innovation from the perspective of innovation outcomes will be addressed, because innovation as a process does not necessarily result in actual innovation. For example, if an R&D project is cancelled due to a lack of feasibility, there has been an innovation process but no innovation outcome. The aim for this thesis is to explain the effect of independence on innovation outcomes. Innovation outcomes are a measure of innovation success. As a side note, innovation as a process should not be confused with process innovation. The latter will be addressed later on.

An innovation can be classified according to the degree of change it causes in an organization (Damanpour, 1991; Gopalakrishnan & Damanpour, 1997). The degree of change can be seen as the amount of new knowledge an innovation contains (Dewar & Dutton, 1986). Radical innovation entails fundamental and revolutionary changes and creates new products, technologies or services; it can make existing innovations obsolete. Incremental innovations, on the other hand, are minor improvements or adjustments in current products, technologies or services; they rely on existing knowledge (Dewar & Dutton, 1986; Damanpour & Wischnevsky, 2006). Radical innovation is associated with firms that have an experimental culture, an entrepreneurial climate, a loose and informal structure, and strong technical competencies. Firms that develop radical innovations are often relatively young and small (Damanpour & Wischnevsky, 2006). Innovative start-ups typically possess the aforementioned associations and firm characteristics. Furthermore, phenomena like experimental culture and loose informal structure can be

linked to firm independence, because they imply the freedom to take risks and the absence of external (formalized) control on decision making. Therefore, radical innovation is expected to be more relevant for the relationship between independence and innovation than incremental innovation. The theoretical distinction between radical and incremental innovation is not clear-cut (Dewar & Dutton, 1986). However, in order to conduct a meaningful empirical analysis, a clear boundary for innovation radicalness should be established. For this thesis, innovations that only consist of small changes in existing products or technologies are not included. If all innovations would be included in this research and no bottom limit would be established, every minor change in current technology, no matter how small, would be considered an innovation. This would decrease the quality of the research outcomes.

The degree of newness of an innovation can be a relevant factor. An innovation can be new to the market (NTTM), which means that no other firm in the market has generated that particular innovation before. An innovation can also be only new to the firm (NTTF). Such an innovation is new for the firm that has adopted it, but it has already been generated before by another firm. NTTF innovations are also called imitative innovations, because they are copies of existing innovations. Firms that belong to a group can use knowledge transfer to access existing innovations from other firms in their group (Sadowski & Sadowski-Rasters, 2006). This possibility is one of the main reasons for technological acquisitions. Since acquisitions lead to a loss of independence of the target firm but also to group membership, the distinction between new-to-the-firm and new-to-the-market is expected to be relevant for the impact of independence on innovation. Note that the distinction between NTTF and NTTM innovation is somewhat different from the distinction between incremental and radical innovation; a radical innovation does not necessarily have to be new to the market, and vice versa. For example, a firm introducing a new product that is radically different from their existing products does not have to be the first in its market to introduce that new product. When a small improvement is made to an existing product, there is always one firm that is the first in its market to make that improvement, even though it is not a radical innovation.

The distinction between technical innovation and administrative innovation is very common in innovation research and is based on the purpose of the innovation. Technical innovation refers to products, processes and other technologies that are used to make products or offer services which are part of the primary activities of an organization. In contrast, administrative innovation is indirectly related to the primary activities of the organization, but directly related to managerial aspects like organizational structure, administrative processes, management systems and human resources. Administrative innovation affects the social system of an organization with rules, roles, structures and procedures (Gopalakrishnan & Damanpour, 1997; Damanpour et al., 1989). The adoption of technical and administrative innovation does not relate equally to the same predictor variables (Damanpour, 1991). Existing research on innovation has primarily focused on technical innovations (Damanpour & Wischnevsky, 2006). One of the main causes for a loss of independence is getting acquired. Since most

innovation-driven acquisitions are made specifically for getting access to the technical innovation of the target firm – hence the term 'technological acquisitions' – it makes sense to focus on the type of innovation that forms the underlying reason for such acquisitions. Therefore, this thesis will concentrate on technical innovations.

Technical innovation can in turn be divided into technical product and process innovation (Damanpour, 1991). This distinction is based on the areas and activities that are affected by the innovation (Gopalakrishnan & Damanpour, 1997). Product innovations are new products and services that are implemented for the benefit of an organization's customers or clients, by meeting a need of an external user or market. Process innovations on the other hand are new tools, devices and knowledge in throughput technology that are introduced into an organization's production process or service rendering process (Gopalakrishnan & Damanpour 1997, Damanpour 1991). This entails that product innovations are primarily customer driven, whilst process innovations are mainly driven by efficiency motives (Damanpour & Gopalakrishnan, 2001). Each type of innovation requires distinct innovation activities and the adoption requires different organizational skills (Murat Ar & Baki, 2011; Damanpour & Gopalakrishnan, 2001). Therefore, a distinction between the two types of technical innovation should be made when conducting research. Several studies have shown that product and process innovation follow distinct processes and do not necessarily have the same determinants (Becheikh et al., 2006). It is therefore sensible to focus on one type of technical innovation at a time. Since product innovations are customer driven and market focused, they are expected to play a more important role in innovation-driven acquisitions than process innovations. After all, many M&A are conducted as a means to increase market share (Valentini, 2012). The introduction of new products is considered as a major indicator of a firm's innovation success (Puranam et al., 2006). Also, product innovation is more strongly related to firm performance than process innovation (Murat Ar & Baki, 2011). For the aforementioned reasons, product innovation is thought to be most relevant for investigating the impact of firm independence on innovation.

To conclude, innovation can be defined as the development and/or use of something new. Because the concept of innovation is broad and has many possible distinctions, choices regarding which ones should be considered are crucial in innovation research. This thesis will focus on the adoption of technical product innovation outcomes: technical, because many acquisitions are driven by the need for new technologies; and product innovation, because it is most directly related to market demand and firm performance. Product innovations are divided into two categories: new-to-the-market (NTTM) innovations and new-to-the-firm (NTTF) innovations. The reason for this division is because the two types of product innovation might be affected by firm independence in a different way. This will be explained later on. Minor changes in existing products are not included as innovations in this research.

2.2.2. Firm independence

The second key concept of this research is firm independence. In existing theory, independence – also referred to as autonomy – is not as widely discussed and examined as the concept of innovation. However, still a number of relevant conclusions can be drawn from studies that use independence or autonomy as a concept. These studies will be analyzed below in order to establish and explain the concept of independence and define its scope for this thesis. Since the concept of independence is not completely unambiguous, it is important to identify the underlying (and more operational) aspects of firm independence.

Nooteboom (1994) defines independence as the freedom in setting goals, choosing a location, the method of production, the work conditions and the form of organization. In line with this definition, Van Gelderen & Janssen (2006) argue that autonomy entails decisional freedom, which means that a person or a firm can make its own choices independent of others. According to Venaik et al. (2005), autonomy refers to the locus of decision-making. It is seen as the extent to which the power to make decisions is allocated to a firm, thereby reflecting its degree of decision-making freedom (Venaik et al., 2005). Thus, independence is the freedom of a firm to make its own decisions about the activities and goals of that firm, independent of other firms.

In their study on organizational autonomy in public organizations, Verhoest et al. (2004) provide a comprehensive definition of the concept of autonomy by reviewing a number of relevant studies. Even though this article describes the autonomy of governmental agencies in their relationship with the government, its definition of autonomy is still useful for defining the concept of independence in private firms. The authors use various aspects of autonomy, drawn from existing literature, to create the concept. Autonomy can be seen as the amount of decision-making competencies. It refers to the scope and the extent of the organization's capabilities concerning decision-making and entails the absence of (ex ante) control by external actors. Managerial and policy autonomy are part of this type of autonomy. Human Resources management, which includes the selection of valuable employees, is part of managerial autonomy. Decisions about the processes and procedures concerning production belong to policy autonomy. Autonomy can also be seen as the exemption on (ex post) constraints on the actual use of decision-making competencies. This type of autonomy refers to the absence of structural, financial, legal and interventional constraints on the organization's decision-making powers (Verhoest et al., 2004). When looking at these aspects of autonomy jointly, autonomy is an organization's ability to make its own decisions concerning management, policy and strategy and it implies the absence of external limitations and interventions on the use of this ability by the firm. For the relationship between independence and innovation, all of the aforementioned characteristics of autonomy appear to be relevant. The amount of decision-making competencies can be linked to the freedom of a firm to decide upon its own innovation policy, independent from others. Attracting talented employees and deciding

upon production processes are also connected to innovation activities. The absence of constraints on decision-making can be related to the execution of the innovation policy and the allocation of funds to R&D activities. Since both of the aforementioned aspects of autonomy are relevant for a firm's innovation activities, both fall under this thesis' concept of firm independence.

When a firm has one or more investors in the form of external shareholders, it usually does not have decision-making autonomy. After all, shareholders have the right to cast their vote on certain firm-related matters and thereby possess a certain amount of decision-making power. In return for their investment, external shareholders can express their opinion on various aspects of the firm and use their vote. However, as long as an external shareholder does not have majority ownership of a firm, it cannot control that firm by itself. In this context, one could argue that various degrees of firm independence exist. After all, even though their power is limited, minority shareholders can also influence a firm's decision making to a certain extent. For this thesis however, a line is drawn at majority ownership of the firm. This line can be seen as the turning point of independence. If there is an external party with majority ownership of a firm, the firm cannot be regarded as independent. As stated before, this is the case when a firm is acquired by another firm. Even though shareholders from Dutch firms do not have the power to decide upon the firm's strategy, majority shareholders can usually choose and appoint the firm's board members. This means that they can control the strategy, management and other decision making of the acquired firm through their power as a majority shareholder. If a firm's majority shareholder is a VC, it means that the firm in question is also financially dependent on an external actor. Note that if there is an internal majority shareholder, for example the director of the firm, the decision-making power connected to those shares remains inside the firm and therefore the firm can still be considered as independent.

Some scholars use the distinction between group firms and non-group firms in order to establish whether a firm is independent or not. Czarnitzki & Delanote (2015) consider firms as independent when they are not part of a group. Both the OECD (2010) and Frenz & Ietto-Gillies (2007) use a similar reasoning: firms that are not part of a larger group are independent. Puranam & Srikanth (2007) state that integration of a firm into a group after being acquired results in a loss of autonomy, because it becomes a subsidiary of its acquirer. Subsidiary firms are thus considered not to be independent. A firm is regarded as a subsidiary when another firm – i.e. the parent firm – has majority or full ownership. The parent firm can control the subsidiary firm, which means that the parent firm has the ability to influence and control the decision making of the subsidiary. The parent firm and its subsidiary firms together form the corporate group. A subsidiary is part of the group and is controlled by its parent firm; therefore, it is not independent. However, while the aforementioned statements from theory that non-group firms are independent are correct, being part of a corporate group does not automatically mean that a firm is not independent. After all, a firm that is the corporate HQ of a group is part of that group, but at the same time can be seen as independent, since the other group firms (the HQ's subsidiaries) do not have the

power to control their parent's decision-making. In this thesis, non-group firms are considered to be stand-alone firms, since they do not have a parent or subsidiaries.

From the aforementioned considerations about independence, the conclusion can be drawn that firm independence refers to the freedom of a firm establishment to make decisions about the actions, activities, goals, policy and strategy of that firm and the freedom to undertake the actions that are needed to execute these decisions. Independence further implies that there is an absence of control, constraints or interventions from parent firms or other (major) external shareholders. When a firm is not part of a group, it can be seen as independent, since it is not controlled by another firm. However, being independent does not automatically lead to the conclusion that a firm is not part of a group. After all, HQ firms also possess decision-making autonomy since they are not controlled by other firms.

This thesis will investigate independence at the level of firm establishments. By focusing on firm establishments, the risk that multiple subsidiaries or a HQ firm and its subsidiaries are seen as one entity is reduced to a minimum. A firm establishment's independence can be determined by verifying whether that firm belongs to a group and if so, whether it is a HQ or a subsidiary. Therefore, in this thesis three categories of firm establishments are identified: stand-alone firm establishments, HQ firm establishments, and subsidiaries. Stand-alone and HQ firm establishments are regarded as independent, whereas subsidiaries are not. HQ firm establishments and subsidiaries are both considered as group firms; stand-alone firms are not.

2.3. Relationship between firm independence and innovation

Now that the key concepts of innovation and independence have been defined, the question arises what theoretical and empirical knowledge already exists regarding the relationship between innovation and independence. In order to answer this question, existing theory and empirical studies will be reviewed. The relationship between the key concepts will be addressed from several perspectives. First, paragraph 2.3.1 will give an extensive overview of the theoretical views on the relationship between independence and innovation. These views will form the theoretical basis for the proposed relationships between product innovation and firm independence. Next, paragraph 2.3.2 will elaborate on existing empirical evidence that is relevant to the relationships between the key concepts. These empirical studies will be used to verify and – if necessary – adapt the expectations that are derived from theory. Paragraph 2.3.3 discusses the impact of firm youthfulness on the relationship between innovation and independence. Finally, paragraph 2.3.4 addresses the difference between NTTM and NTTF innovation in its relationship with firm independence. The combined findings from theory and existing empirical studies will be used to formulate hypotheses.

2.3.1. Views from theory on relationship between firm independence and innovation

Existing theory on the relationship between firm independence and innovation is quite limited. When it is addressed in the literature, it is usually in conjunction with M&A. Even though acquisitions are not the only situations in which decision-making autonomy can play a role in the level of innovation of a firm, the existing theory on M&A can give useful insights regarding the impact of independence on innovation. Therefore, it is used as a starting point for making presumptions on the impact of firm establishment independence on innovation. Additionally, the innovation benefits that group firms might have due to their group membership will be discussed, because these benefitis might (partially) compensate for any negative impact of not being independent on innovation.

2.3.1.1. Innovation and firm independence

As stated before, many M&A are driven by the desire of the acquirer to access externally developed innovation and thereby ultimately increase firm performance and/or market share. Technological acquisitions are acquisitions that are made with the purpose to access innovative technologies within the target firm. The advantage for the acquirer is that it does not have to develop the necessary technologies and innovations internally, because it can transfer this valuable knowledge from the target firm to itself. This saves time and effort and decreases uncertainty. Furthermore, if a target firm retains (or increases) its innovation-related capabilities after M&A, the acquiring firm can make use of the acquired firm's future innovations (Puranam & Srikanth, 2007). In turn, such knowledge transfer could also stimulate innovation in the acquiring firm itself. Prabhu et al. (2005) argue that when technological acquisitions are combined with internal innovation, they can improve an acquirer's product innovation. Continuous innovation in the acquired firm is therefore also beneficial for innovation in the acquiring firm. The question arises how acquirers should leverage acquired technology and make best use of it (Puranam & Srikanth, 2007).

As explained earlier on, one of the consequences of M&A can be a loss of independence for the acquired firm, as a result of integration into the acquirer's group. The stream of theory in which the pros and cons of independence in relation to innovation are addressed most elaborately, is that on technological acquisitions. A central theme of this literature is the dilemma that can arise between coordination and autonomy of the acquired firm. This body of literature can give valuable insights into the relationship between independence and innovation, because it discusses the effects of autonomy on innovation at the level of the acquired firm. Below, the relevant sources regarding this subject are discussed.

An acquisition is usually followed by the process of incorporating the target firm into the acquirer's group. According to Berggren (2003), after M&A, innovators become absorbed in harmonization and coordination issues, instead of concentrating on innovation and new product development. This is considered an important reason for bad innovation performance after M&A. In order to reach the

economies of scale and synergies that were predicted, hierarchical structures are reinforced by the acquirer. To achieve these structures, standardization and formalization become a priority. All these activities distract from innovation. People in creative positions – such as R&D – tend to be transformed into implementers, standardizers or engineering bureaucrats and have to report to new organizational and hierarchical layers. These consequences of M&A, which are related to the loss of autonomy of the acquired firm, may erode the capacity for future innovation in the acquired firm. As a result, innovation projects are at risk, particularly those projects that are uncertain and depend on project autonomy (Berggren, 2003).

In their article on technology acquisitions, Puranam et al. (2006) address the (seemingly contradictory) strategies of coordination and autonomy in a comprehensive manner. According to the authors, acquirers have to integrate acquired firms into their corporate structure in order to benefit from the acquired technologies and must do so in a coordinated matter, but at the same time should preserve (some) organizational autonomy for the acquired firms. According to the authors, autonomy can be preserved by pursuing structural separation. Autonomy is thought to be crucial for not disrupting the acquired firms' capacity for continued innovation. After all, less task autonomy will lead to less intrinsic motivation, which can in turn lead to valuable employees leaving the firm. Furthermore, changes in the acquired firm that are implemented can change organizational routines and thereby undermine the innovative capacity of that firm (Puranam et al., 2006).

According to Puranam & Srikanth (2007), organizational integration mechanisms can enhance knowledge transfer and coordination between the acquiring firm and the acquired firm, but they can also disrupt organizational processes as a result of reduced organizational autonomy. When acquirers mainly want to exploit the existing knowledge and innovation of an acquired firm as input to their own innovation activities, a focus on coordination is favorable. However, when acquirers want to use the firm as an independent source of continuous innovation, integration can hinder the goal of the acquirer to leverage the innovative capabilities of the acquired firm, because it puts an end to its independence. The effect of losing autonomy reduces the capacity of (inventors in) the acquired firm to keep innovating following the acquisition in two ways. First, integration leads to standardization of work practices and procedures, which can lead to a disruption of existing routines and undermine innovative capabilities of the acquired firm. Second, it can lead to decreased intrinsic and extrinsic motivation and productivity, because it weakens the link between reward and effort. Talented employees are often attracted by smaller organizations, because these firms can offer high-powered incentives. Integration increases the size of firm, which leads to more free riding and hinders sharp incentives. As a result, talented employees become demotivated and might leave the firm (Puranam & Srikanth, 2007). There appears to be general agreement among scholars that autonomy in technology acquisitions minimizes disruption in the target firm, which results in preservation of motivation and capacity for ongoing innovation at the acquired firm (Puranam & Srikanth, 2007). So, on the one hand, acquirers want to integrate their target to benefit

from the possibilities of knowledge transfer. On the other hand, M&A can harm the innovative capabilities of the target firm due to the loss of independence.

Ranft & Lord (2002) argue that autonomy is an important means of trying to protect the technologies and capabilities of the target firm during the M&A implementation process. The preservation of this knowledge is crucial for transferring the innovative technologies and capabilities later on. Even though autonomy might be necessary for preserving target firm knowledge, it can also form a barrier that prevents knowledge from being transferred from the acquired firm to the acquiring firm (Ranft & Lord, 2002). However, this does not necessarily mean that it has a negative effect on innovation in the acquired firm; it only prohibits the acquirer from exploiting the innovation in the target firm.

So, even though full autonomy might be the ideal scenario for continuous innovation in the acquired firm, for the acquiring firm some level of integration is needed to be able to profit from the innovation that resides in the acquired firm. Autonomy for an acquired firm after M&A therefore does not look like a realistic scenario, since it hinders the acquirer from achieving the transfer of knowledge for which the firm was acquired. Consequently, a firm that is acquired is expected to lose its autonomy as a result of being incorporated into the group, at least to a certain extent. This means that the acquiring firm takes away the acquired firm's independence by transferring (some of) the acquired firm's decision-making to itself.

After technology acquisitions, R&D activities in the target firm are usually reduced in order to make it (more) profitable. This course of action reflects the exploitation of the target firm by the acquirer. Szücs (2014) points out that even though it might be lucrative for the acquirer to do so, the consequence of this exploitation is the elimination of a (highly) innovative firm from the market. When this occurs, a loss of independence as a result of M&A is clearly harmful for ongoing target firm innovation. Consequently, the acquirer cannot profit from continued innovation in the acquired firm.

The aforementioned arguments can be summarized as follows. In theory, views on the relationship between firm independence and innovation are mostly made in conjunction with technological acquisitions. Such acquisitions are used to access externally generated innovations. Through knowledge transfer, acquirers can profit from both existing and future innovation in target firms. In order to successfully transfer the acquired knowledge, integration of the firms is necessary. This takes away the autonomy of the acquired firm. Such a loss of independence is thought to have a negative effect on the capacity for ongoing innovation in the target firm, which means that the acquired firm becomes less innovative. As such, it can be expected that independent firms are generally more innovative than their non-independent counterparts. In paragraph 2.3.2, empirical studies are reviewed to further test this presumption.

2.3.1.2. Innovation and group membership

So far, theory indicates that independence is positively related to innovation. For acquiring firms engaging in innovation-driven M&A, the main objective is to profit from the target firm's innovation. The question arises if this could also work the other way around, or in other words, if an acquired firm could improve its innovation performance by using knowledge and other resources from its acquirer.

The presumption that access to intragroup knowledge and resources can be beneficial for innovation in group firms might be of relevance when looking at the relationship between firm establishment independence and innovation. A group firm can probably access knowledge from other firms within its group. A lack of autonomy is expected to affect innovation in a negative way, whereas knowledge transfer might positively affect innovation. For HQ's, it would mean that they could improve their innovation with knowledge from other group firms. For subsidiaries, it would mean that knowledge transfer due to group membership could (partially) compensate for their lack of autonomy when it comes to innovation. Thus, in order to make meaningful statements on the relationship between independence and product innovation, the possible counter-effect of group membership on innovation should be looked into.

In theory, the possibility of knowledge transfer for firms that belong to MNEs is frequently discussed. Many scholars have argued that the superior performance of such subsidiaries is due to knowledge transfer from their parent firms (Guadalupe et al., 2012). Parent firms might transfer (part of) their technology to their subsidiaries. This knowledge transfer could stimulate R&D activities in the subsidiaries, because such knowledge is necessary to adopt new technologies (Stiebale & Reize, 2011). The fact that subsidiaries can learn from their parent and other subsidiaries in their group can give them an advantage in terms of innovation (Dachs & Peters, 2013). All in all, there appears to be shared consensus in business and innovation literature that by using resources and capabilities from other firms in their group, subsidiaries can develop capabilities which can increase their innovative capacity (Collinson & Wang, 2012). On the other hand, however, the possibility of knowledge transfer can also reduce the incentives for target firms to conduct their own innovative activities (Stiebale & Reize, 2011).

Since the theory addressed above focuses on multinational groups, it is unsure if the expected benefits of knowledge transfer described in the aforementioned articles also apply to domestic groups. After all, unlike domestic groups, MNEs operate in multiple geographical markets and as a result might have access to more and more diverse sources of knowledge than domestic firms (Collinson & Wang, 2012). On the other hand, knowledge transfer between domestic group firms might be easier than between multinational group firms, because MNEs have to deal with issues like geographical distance, language barriers and cultural differences (Ambos & Ambos, 2009). So even though theory only mentions the innovation-related advantages of knowledge transfer for multinational group firms, the same advantages might also exist for domestic group firms.

Based on the aforementioned considerations, it is arguable that group membership might have a positive impact on product innovation. If correct, this would mean that a negative impact of not being independent on innovation in subsidiaries could be reduced by the fact that such firms have access to additional resources and knowledge. In paragraph 2.3.2, existing empirical evidence is evaluated to see whether there is existing empirical support for these theory-based presumptions.

2.3.2 Empirical evidence on the relationship between independence and innovation

Based on the argumentations in theory as described in paragraph 2.3.1, it is expected that independent firms (i.e. HQ's & stand-alone firms) are generally more innovative than non-independent firms (i.e. subsidiaries). After all, losing independence is thought to have a negative impact on innovation as a result of an increase in hierarchy, formalization and/or standardization. Therefore, firm independence is thought to be positively related to innovation. In this sense, preserving autonomy can be a way to protect the innovative capabilities of a firm. One should however take into account that the possibility of knowledge transfer and access to other resources might (partially) compensate for the absence of independence in subsidiaries.

The next step is to see whether there is existing empirical evidence that can support these presumptions. First, evidence from research on the effect of M&A on innovation is addressed, because of its connection with firm independence. Next, results from studies on the effects of losing autonomy after being acquired on innovation are discussed. These studies address the concept of independence explicitly and are therefore particularly useful. After that, results from studies that investigated the effect of (not) being part of a group firm on innovation are discussed. The empirical evidence addressed in this paragraph will be used to support, extend and – if necessary – modify the expectations regarding the impact of firm independence on innovation. At the end of this paragraph, hypotheses will be presented.

2.3.2.1. Effect of M&A on innovation

One of the consequences of M&A is that the target firm loses its autonomy. Therefore, research on the effect of M&A on innovation can be useful for this theoretical framework. Most of the existing research treating the effect of M&A on innovation does not address the role of losing independence of the acquired firm. However, as stated before, this body of research can still provide useful insights on the relationship between innovation and independence. To date, empirical research on the effects of M&A on innovation has provided mixed results (Ensign et al., 2014). Below, relevant empirical studies are addressed to show the different viewpoints on the impact of M&A on innovation.

In his research on SMEs in the Dutch manufacturing sector, Cefis (2010) finds that M&A activities can have a positive impact on R&D investments. However, this does not necessarily mean that the innovation output also increases. After all, even though they are important for innovation output, R&D

investments are only an input to innovation. Gantumur & Stephan (2011) find that mergers can increase innovation performance in firms, but do not result in a higher level of R&D productivity. Valentini (2012) shows that M&A have a positive effect on patenting output, but at the same time have a negative effect on patenting impact, originality and generality. This negative effect is thought to be the result of increased pressure on the acquired firm to achieve immediate (short-term) results following M&A (Valentini, 2012). So even though findings from these studies imply a positive effect of M&A on innovation at first glance, their context and limitations make them questionable.

In contrast to the aforementioned articles, there is a significant amount of research that does not find any positive effect or finds a negative effect of M&A on innovation. Some of these articles mention innovation of the target firm explicitly, which makes them particularly relevant for this thesis. Hitt et al. (1990) state that acquisitions can lead to reduced commitment to pursuing risky projects. Furthermore, acquisitions lead to an increase in firm size, which results in more formalization and more bureaucratic controls. The acquisition process consumes a lot of time and attention. All these consequences can lead to reduced managerial commitment to innovation. The results of Hitt et al. (1991) confirm that acquisitions have a negative effect on both R&D inputs and outputs. Their findings suggest that acquisitions do not lead to synergy gains in terms of R&D and that the innovativeness of target firms may reduce after being acquired. Hitt et al. (1996) also find a negative effect of acquisitions on internal innovation of both acquiring and target firms. Both types of firms have to put a lot of attention and energy into the acquisition process. As a result, long-term decisions are postponed and risk aversion increases (Hitt et al., 1996). In their research on innovation in target firms, Stiebale & Reize (2011) argue that even though target firms might benefit from technology transfer from their parent firms, this can also reduce the incentives for target firms to innovate themselves. The results of their study show that acquisitions indeed have a negative effect on both innovation propensity and R&D expenditures in target firms. The scholars do not find any evidence of technology transfer in the form of higher innovation success for acquired firms (Stiebale & Reize, 2011). Szücs (2014) investigates the impact of M&A activities on R&D, making a distinction between acquiring firms and target firms. The results show that for target firms, M&A have a substantial negative effect on both R&D intensity and R&D growth. This indicates that acquirers prefer to exploit their target's R&D, rather than using it for continued innovation in the long run (Szücs, 2014). Ornaghi (2009) also finds evidence that M&A have a negative effect on innovation. The results further imply that higher technological relatedness between the acquirer and the target does not lead to better innovative performance after M&A. In their review of empirical studies on the effects of M&A on innovation, De Man & Duysters (2005) find negative or neutral effects of M&A on innovation. None of the studies that the authors reviewed in their study show a positive effect.

So, even though in research sometimes positive effects of M&A on innovation are found, these findings are not convincing. Most scholars find either an ambiguous effect or a negative effect of acquisitions on

innovation. The negative impact of M&A on innovation that was found in empirical studies might be caused by a loss of independence for the acquired firm. The reasoning behind this is as follows. When firms are acquired for their innovation and/or innovative capabilities, acquirers try and integrate the acquired firm into their group. By integrating a target firm, acquirers hope to get access to the innovative knowledge of the target firm and transfer it within their group. As described in the previous paragraph, the desire for integration leads to the adaptation of procedures and practices of the target firm. These alterations are imposed on the target firm by using control mechanisms such as hierarchy, standardization and formalization. All these measures, which are taken by the acquirer, take away the independence of the target firm. This ultimately leads to a decrease in innovation performance in the acquired firm. In this sense, the unpromising research results of the effect of M&A on innovation support the view that a loss of independence has a negative effect on innovation and therefore that independence is positively related to innovation. This supports the presumptions from theory as described in the previous paragraph. Furthermore, the empirical findings on M&A addressed in this paragraph suggest that the possibility of knowledge transfer does not compensate for the lack of independence in subsidiaries. This will be discussed more elaborately later on.

2.3.2.2. Effect of losing independence on innovation

The empirical results addressed above provide insight into the effect of M&A on innovation. However, these articles do not make statements about the role of losing independence in the innovation performance of acquired firms, even though being acquired generally leads to the acquired firm losing its autonomy. However, there are several studies that do take the factor of autonomy into account when looking at the effects of acquisitions on innovation. Their results are discussed below.

The results of a study by Puranam et al. (2006) show that structural integration of an acquired firm with the acquiring firm decreases the chance of successfully launching the first product innovations after the acquisition. The negative consequences of the loss of autonomy – as a result of such integration – are particularly high during the exploration phase of innovation. Exploration consists of product definition, conceptual design, prototyping and testing. Exploitation on the other hand consists of manufacturing, marketing and distribution. When it comes to the first product innovations of a firm, exploration is more important for innovation outcomes than exploitation. This is because later innovations can usually build on the knowledge that was generated during the exploration activities for the earlier innovations (Puranam et al., 2006). The unique innovative capabilities of a firm appear to be especially important for exploration, because the activities during exploration are characterized by creativity and inventiveness. The results of this study thus indicate that a loss of autonomy has a negative impact on the innovative capabilities of an acquired firm.

In their research on technology acquisitions, Puranam & Srikanth (2007) also find significant disruptive effects of the loss of autonomy on innovation in acquired firms. Furthermore, they conclude that these

effects do not weaken over time. This means that the loss of autonomy has long-term negative consequences for technical innovation in the acquired firm (Puranam & Srikanth, 2007). These findings are in line with the expectations from theory as described in the previous paragraph.

In their research on innovation in MNEs, Venaik et al. (2005) show that autonomy is positively related to innovation. According to the authors, autonomy motivates and encourages managers to find new and better ways of carrying out their activities. Ghoshal & Bartlett (1988) also find that MNE subsidiaries with higher levels of autonomy create more product innovations. Birkinshaw et al. (1998) show that subsidiary autonomy is strongly related to the subsidiary's contribution and initiative concerning firm-specific advantages. Innovation can be seen as a contribution to firm-specific advantages, because innovations are part of the technological resources of a firm.

The aforementioned research has thus shown that for the acquired firm, not having independence generally is harmful for innovation. Autonomy is necessary to avoid a disruption of its innovation. Too much integration impedes post-acquisition innovation of the target firm and can hinder leveraging its ongoing innovation. Based on these findings, it can be argued that not being acquired – and thus staying independent – might be best in terms of ongoing innovation. This is in line with the expectation that independence is beneficial for innovation that was made earlier. As such, stand-alone firms and HQ firms should perform better in terms of innovation than subsidiaries.

2.3.2.3. Effect of group membership on innovation

So far, this chapter has shown that existing theory and empirical evidence appear to demonstrate a negative relationship between not having autonomy and innovation. The question remains whether group membership could be beneficial for product innovation and thereby possibly mitigate negative effects of not being independent on innovation in subsidiaries to some extent. As for HQ firms, they could profit from both autonomy and group membership. As described in paragraph 2.3.1.2, a group firm may be able to profit from the other group firms' knowledge, resources and assets, which in turn could have a positive effect on innovation. Stand-alone firms cannot profit from such intragroup knowledge transfer, but are expected to have an innovation advantage due to their autonomy.

In existing theory, the positive impact of intragroup knowledge transfer on innovation appears to be attributed primarily to MNEs, probably because they operate in various markets and therefore have access to more (diverse) sources of knowledge. It is therefore uncertain if these arguments from theory are also valid for domestic group firms. Some existing empirical studies look at the differences between group firms and non-group firms in terms of innovation. The results of this research can shed more light on the role of intragroup transfer of knowledge and resources in the relationship between independence and innovation. These results are discussed below.

In their research on the innovativeness of firms in the Netherlands, Sadowski & Sadowski-Rasters (2006) provide evidence that belonging to a (domestic) group does not have a positive effect on generating innovations. Here, both subsidiaries and HQ's qualify as group firms. Such firms do not score higher on new innovations when compared to non-group firms (Sadowski & Sadowski-Rasters, 2006). In a similar study, Frenz & Ietto-Gillies (2007) show that firms belonging to a (domestic or multinational) group generally have a higher innovation propensity than stand-alone firms. However, they also find that firms belonging to a multinational group show a higher innovation propensity than firms in a domestic group. This however does not seem to be caused by group membership, since their findings show that the higher levels of innovation propensity identified in MNE group firms are caused predominantly by multinationality, and not so much by group membership itself. When the researchers compared firms in in domestic groups (subsidiaries & HQ's) to non-group firms, they did not find any effect on innovation outcomes in those firms (Frenz & Ietto-Gillies, 2007). Thus, considering the fact that many group firms belong to a multinational group, the aforementioned results indicate that being part of a group itself does not have a positive effect on innovation, compared to being a non-group firm.

The aforementioned empirical studies indicate that group firms generally do not perform better in terms of innovation than non-group firms. In other words, HQ's and subsidiaries do not appear to score better on innovation than stand-alone firms. Therefore, it is expected that intragroup knowledge and resource transfer does not compensate for the lack of independence in subsidiaries when it comes to innovation outcomes. After all, if such transfer would take away any negative impact of non-independence on innovation, subsidiaries should score better on innovation than non-group firms. Since this is not the case, the presumption that independence is beneficial for innovation that was made earlier on can be maintained. The fact that subsidiaries belong to a group does not affect the aforementioned presumption about firm independence. Furthermore, the view that HQ firms perform better on innovation than non-group firms due to their group membership is not supported by the abovementioned empirical results.

2.3.2.4. Conclusion and hypotheses

The conclusions from Paragraph 2.3.2 are as follows. The somewhat unpromising results of studies on the impact of M&A on innovation support the view that firm independence is positively related to innovation. Research has shown that autonomy is indeed positively related to innovation and that a loss of autonomy can disrupt innovation performance. Furthermore, even though non-independence presupposes group membership and thus access to intragroup knowledge and other resources, existing research indicates that group membership does not compensate for a lack of independence in subsidiaries and that group membership does not make HQ firms more innovative than stand-alone firms. Based on the theory and empirical results addressed so far, it is expected that being independent is beneficial for product innovation in firm establishments. Therefore, independent firms (i.e. stand-alone firms and HQ's) should perform better than non-independent firms (i.e. subsidiaries) in terms of product

innovation. From these conclusions and the findings in this paragraph, the first two hypotheses can be formulated:

Hypothesis 1a: Stand-alone firm establishments are more likely to introduce product innovations than subsidiary firm establishments.

Hypothesis 1b: HQ firm establishments are more likely to introduce product innovations than subsidiary firm establishments.

2.3.3 Firm youthfulness as moderator of the relationship between independence and innovation

Now that the relationship between the concepts firm independence and innovation has been hypothesized, the next step is to see if there are any other factors that could play a role in this relationship. As already mentioned in Chapter 1, start-ups are desirable targets for technological acquisitions, because nowadays many successful innovations come from such firms. Start-ups cannot rely on existing products, an established market share or an existing customer base; they need to innovate in order to survive and prosper. Often, these young firms are still independent when they generate their first innovation(s). Once other firms find out that a certain start-up possesses valuable innovative knowledge and/or capabilities, the start-up could become an acquisition target and as a result might lose its autonomy. Since innovation is so important for young firms and since not being independent is expected to have a negative impact on innovation, the impact of independence on innovation might be bigger for younger firms (i.e. start-ups) than for older firms. In other words, the youthfulness of a firm might interact with the relationship between independence and innovation. In recent years, there appears to be a specific interest in young innovative firms in technological acquisitions. Therefore, it is useful to investigate whether the youthfulness of a firm might be of relevance in the relationship between independence and innovation.

The youthfulness of a firm can be derived from its age: the younger the firm, the more youthful it is. The relationship between firm age (or youthfulness) and innovation has not yet been clearly established. In theory, there are various – sometimes opposing – arguments about this relationship. On the one hand, age could be beneficial for innovation, because older firms have more experience and a larger knowledge base. These attributes can help firms to generate or adopt innovations more efficiently. On the other hand, age could harm innovation, because it makes it harder to make changes to existing routines and procedures. As a result, responding and adapting to (external) technological advances is more difficult (Becheikh et al., 2006; Damanpour & Wischnevsky, 2006). Sorensen & Stuart (2000) find that as organizations get older, they generate more innovations, but at the same time the divergence between organizational competencies and current external demands increases. Huergo & Jaumandreu (2004) find that young firms entering a market have a higher probability to innovate than older firms. However,

firms with intermediate age appear almost as active as young firms in terms of innovation. According to Balasubramanian & Lee (2008), there are two opposing effects from firm age: learning versus organizational inertia. Their research results show that technical innovation quality decreases with firm age. In contrast, Sadowski & Sadowski-Rasters (2006) do not find support for the view that newly established firms are more innovative than older firms.

There is empirical evidence that indicates that the youthfulness of a firm has an influence on the relationship between firm independence and innovation. Puranam et al. (2006) expect that the effect of losing autonomy on innovation outcomes is worse for younger firms than for more established firms, because integration hinders the exploration process. Exploration is what makes these firms innovative and it is thought to be especially important for the innovation activities of younger firms. The results of their research show that the negative impact of not having autonomy on innovation is indeed higher for firms that have not launched any products than for firms that have already introduced new products (Puranam et al., 2006). Firms that have not launched any new products will generally be young firms. The aforementioned study thus implies that for young firms, independence is more important for product innovation compared to older firms. Therefore, it is expected that youthfulness positively influences the relationship between autonomy and innovation, which means that youthfulness acts as a moderator of the relationship between independence and product innovation. Older firms are probably more used to operating in accordance with established procedures and routines, which might make it easier for such firms to comply with the rules of their acquirer. Younger firms will not be as experienced with procedures and routines, making it harder for them to continue their innovative activities when such procedures and routines are implemented by an acquiring firm after losing autonomy.

Based on the aforementioned arguments, when focusing on the relationship between firm establishment independence and innovation, firm youthfulness is expected to interact with this relationship in a positive way. In other words, the difference in the amount of product innovations between independent and non-independent firms is expected to be bigger for younger firms than for older firms. As mentioned earlier, HQ firms and stand-alone firms are both considered to be independent, whereas subsidiaries are non-independent. Therefore, the following two hypotheses are drawn up:

Hypothesis 2a: The younger firm establishments are, the more likely stand-alone firm establishments are to introduce product innovations compared to subsidiary firm establishments.

Hypothesis 2b: The younger firm establishments are, the more likely HQ firm establishments are to introduce product innovations compared to subsidiary firm establishments.

2.3.4 Newness of innovation, independence and group membership

As described in paragraph 2.2.1, an innovation can be new to the market or only new to the firm. The degree of newness of an innovation might be relevant when looking at the impact of independence on

innovation. When an innovation is only new to the firm, some other firm already generated that particular innovation before. As such, a NTTF innovation is an existing innovation that is put into use by a firm. The adoption of an existing innovation can occur between firms that belong to the same group, as a form of intragroup knowledge transfer (Sadowski & Sadowski-Rasters, 2006). Other firms in their groups might have generated useful innovations, which they can adopt. In contrast, an innovation that is new to the market cannot have been transferred from another group firm, since an innovation is only considered to be new to the market if it is generated by the firm that implements it. Therefore, the characteristic of belonging to a group (and the corresponding possibility of knowledge transfer) is expected to be positively related to the amount of NTTF innovations of a firm, but not to the amount of NTTM innovations.

Sadowski & Sadowski-Rasters (2006) study innovation in group firms and non-group firms, making a distinction between NTTM and NTTF product innovations. Both subsidiaries and HQ's are considered as group firms. The results show that domestic group firms do not score higher on NTTM innovations than non-group firms. Furthermore, multinational group firms do not score higher on such innovations either (except when compared to non-innovating firms). This study thus provides evidence that belonging to a group does not have a positive effect on introducing product innovations that are new to the market (Sadowski & Sadowski-Rasters, 2006). In line with the aforementioned results, an empirical study from Frenz & Ietto-Gillies (2007) also shows that belonging to a domestic group, compared to being a non-group firm, does not have a positive impact on NTTM innovations. In contrast to NTTM innovations, Sadowski & Sadowski-Rasters (2006) do find a positive effect of belonging to a group on NTTF innovations. This positive impact is found for both domestic group firms and for multinational group firms. According to the authors, this positive effect on NTTF innovation is found because group firms have the possibility to use knowledge from other group firms in their innovative activities. The results further show that transfer from associated firms is positively related to innovativeness. Group firms thus appear to benefit from the fact that they are part of a group when it comes to NTTF innovation. These findings indicate that it is possible for group firms to exchange innovations with each other.

The aforementioned empirical results lead to the presumption that, when it comes to innovations that are new to the market, group firms (i.e. HQ's & subsidiaries) do not perform better than their non-group counterparts (i.e. stand-alone firms). Unlike NTTF innovations, NTTM innovations cannot be achieved by imitating another group firm. The results addressed in this paragraph show indeed that group membership does not appear to be beneficial for generating NTTM innovations; group firms do not seem to profit from knowledge in their group when it comes to introducing such innovations. Since group membership does not have an impact on NTTM innovations, the presumption that firm establishment independence is beneficial for innovation that was made in the previous paragraph can be maintained for this type of innovation. After all, group membership does not give non-independent firms (subsidiaries) an advantage in NTTM innovation, but such firms are still expected to experience the

innovation disadvantages of not being independent. In other words, when it comes to NTTM innovation, group membership does not compensate for the lack of independence. Thus, for NTTM innovations, stand-alone and HQ firm establishments are expected to perform better than subsidiary firm establishments, because of the autonomy advantages of the former two. This leads to the following two hypotheses for NTTM innovations:

Hypothesis 3a: Stand-alone firm establishments are more likely to introduce new-to-the-market product innovations than subsidiary firm establishments.

Hypothesis 3b: HQ firm establishments are more likely to introduce new-to-the-market product innovations than subsidiary firm establishments.

Since group membership is expected not to have an impact on NTTM innovation, HQ firm establishments should not perform better in terms of NTTM innovation compared to stand-alone firms. Both types of firm establishments are independent, which means that autonomy does not play a role in this comparison. The group membership of HQ firm establishments is not expected to benefit their NTTM innovation compared to stand-alone firms. As a result, the following hypothesis is drawn up:

Hypothesis 3c: HQ firm establishments are just as likely to introduce new-to-the-market product innovations as stand-alone firm establishments.

In contrast with NTTM innovations, the empirical results on innovations that are only new to the firm do show an impact of group membership: group firms are more likely to introduce such innovations than non-group firms. Based on these findings, belonging to a group is expected to be beneficial for the amount of NTTF product innovations of a firm. Group firms appear to profit from their group membership in terms of introducing NTTF innovations. Intragroup knowledge transfer is probably what causes group firms to score better than non-group firms. Since NTTF innovations are 'imitations' of existing innovations and thus based on existing knowledge, group firms can adopt innovations that other firms within their group have generated.

Since group firms can be either independent (HQ's) or non-independent (subsidiaries), autonomy appears not to be the decisive factor for NTTF innovations. After all, existing research shows that group firms perform better on such innovations than (independent) stand-alone firms. This makes sense, since the innovation advantages related to independence – such as autonomous decision making and the freedom to pursue risky R&D projects – are probably less relevant for imitating existing innovations than for creating NTTM innovations. Thus, when focusing on NTTF innovations, HQ firms and subsidiaries are expected to perform better than stand-alone firms, due to group membership of the former two and the corresponding possibility of intragroup knowledge transfer. From these conclusions, the following hypotheses regarding NTTF innovations are derived:

Hypothesis 4a: Subsidiary firm establishments are more likely to introduce new-to-the-firm product innovations than stand-alone firm establishments.

Hypothesis 4b: HQ firm establishments are more likely to introduce new-to-the-firm product innovations than stand-alone firm establishments.

Even though group membership is expected to be decisive in the effect on NTTF product innovation, independence might still be of relevance when comparing HQ's (i.e. independent group firms) to subsidiaries (i.e. non-independent group firms). Both firm types have the innovation-related benefits of group membership. HQ firms however have an additional advantage of being autonomous, from which they might profit. The existing literature on NTTF innovation and group membership addressed above does not make a clear distinction between HQ firms and subsidiary firms. Therefore, it does not contradict such possible innovation differences between these two types of firms. Furthermore, theory and empirical results addressed in this chapter allow for the expectation that autonomy might also be beneficial for NTTF innovations, albeit to a lesser extent than group membership. Therefore, when comparing HQ firm establishments and subsidiary firm establishments, HQ firm establishments are expected to perform better in terms of NTTF innovations because of their autonomy. This leads to the following hypothesis:

Hypothesis 4c: HQ firm establishments are more likely to introduce new-to-the-firm product innovations than subsidiary firm establishments.

The presumption on the influence of firm establishment youthfulness on the relationship between independence and innovation, which was made in paragraph 2.3.3, can also be applied to the aforementioned hypotheses on NTTM and NTTF innovation. After all, Puranam et al. (2006) argue that the interaction effect of youthfulness applies to both NTTM innovations and NTTF innovations. Just as with NTTM innovations, young firms emphasize exploration during the development of NTTF innovations (Puranam et al., 2006). Again, stand-alone firm establishments and HQ firm establishments are considered independent, whereas subsidiaries are not. The following hypotheses are drawn up:

Hypothesis 5a: The younger firm establishments are, the more likely stand-alone firm establishments are to introduce new-to-the-market product innovations compared to subsidiary firm establishments.

Hypothesis 5b: The younger firm establishments are, the more likely HQ firm establishments are to introduce new-to-the-market product innovations compared to subsidiary firm establishments.

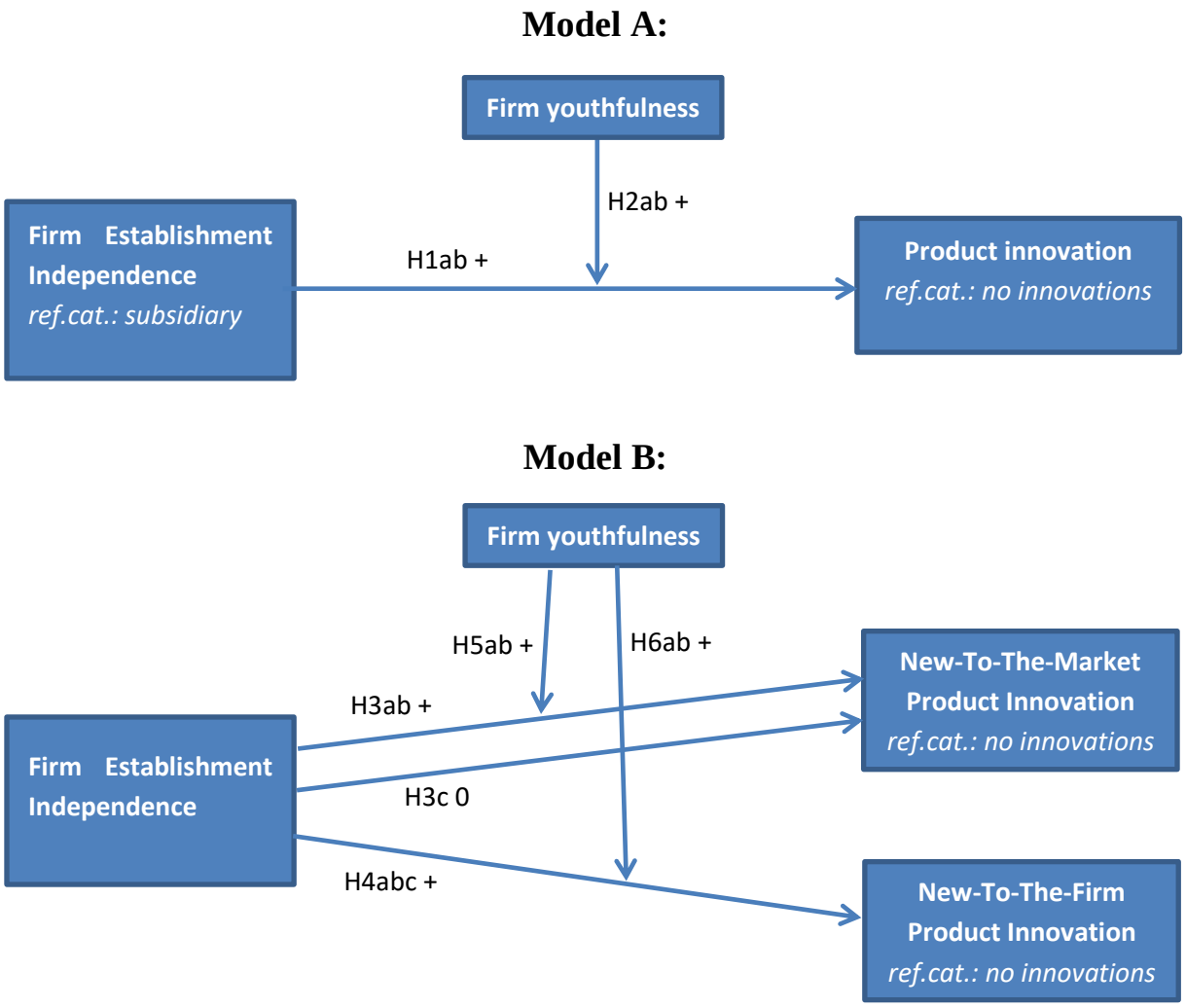
Hypothesis 6a: The younger firm establishments are, the more likely stand-alone firm establishments are to introduce new-to-the-firm product innovations compared to subsidiary firm establishments.

Hypothesis 6b: The younger firm establishments are, the more likely HQ firm establishments are to introduce new-to-the-firm product innovations compared to subsidiary firm establishments.

2.4. Conceptual model

In this chapter, the key concepts have been defined and the existing theory and empirical results on the relationship between them have been discussed. Based on these findings, hypotheses were made. Since the existing theory and empirical evidence does not give a decisive answer on the effect of independence on product innovation, an empirical analysis is required to determine if there is support for the hypothesized relationships. The hypotheses that were mentioned in the previous paragraph can be used to draw up the following conceptual model:

Figure 2.1 – Conceptual model



Chapter 3 – Methodology

3.1. Introduction

In the previous chapter, the hypotheses and conceptual model were drawn up. These are based on the findings in theory and empirical studies. In order to check if the predicted relationships are indeed correct, an empirical analysis is needed. This chapter will address the methods of analysis for this thesis. First, the research design will be presented. Next, the data set and data collection are addressed. Then, the concepts are operationalized and the methods for conducting the analyses are explained. Aspects regarding validity and reliability are discussed. Finally, research ethics are addressed.

3.2. Research design

This thesis will use mixed methods research. This type of research consists of a combination of both quantitative and qualitative research approaches, which can then be used in a single study (Johnson & Onwuegbuzie, 2004; Johnson et al., 2007). The advantage of a mixed method approach is that the strengths of both types of research can be combined. This way, complex research problems can be addressed and limitations of one type of research can be compensated with the other. A combination of quantitative and qualitative analyses leads to more insight than when one of these analyses is used by itself (Creswell, 2009). Mixed methods research can provide stronger evidence, additional insights, more complete knowledge and increased generalizability of the results (Johnson & Onwuegbuzie, 2004).

By using a mixed methods approach in this thesis, a large number of firm establishments can be included into the analysis. At the same time, it is possible to get more in-depth understanding of the phenomena being studied. As such, the advantages of both types of analysis are incorporated into the research. The use of a qualitative method as an addition to the quantitative method can give more insight into the reason why certain effects are being detected (or not) in the quantitative analysis. This results in a more profound understanding of the relationships between the concepts at hand.

For the quantitative part of this research, a survey will be used. A survey is a research design which investigates a multitude of objects in real-life situations. Usually a sample is drawn from the population of similar objects. When the sample is made in the correct manner, the results from the survey can be generalized to make statements about the population from which the sample was drawn. Most of the times, a survey is conducted using a written questionnaire (Vennix, 2009). A survey is the most appropriate quantitative method here, because the main goal of this research is to test the causal relationship between concepts. Furthermore, in a survey a great number of firm establishments can be included into the analysis, which increases the generalizability of the research outcomes. Since the aim is to make statements about the population of firm establishments, a large number of firm establishments should be studied. Finally, as opposed to an experiment, in a survey no variables have to be manipulated.

Not manipulating variables is beneficial for the external validity of the results (Vennix, 2009). Like most surveys, the one used in this thesis has the form of a written questionnaire.

For the qualitative analysis, data will come from open-ended interviews. An interview is a method in which questions are asked and answered in a conversational form. The interviewer has the possibility to interact with the respondent. During an interview, the interviewer can use a previously drafted interview guide and/or previously formulated questions (Vennix, 2009). The advantage of using an interview is that the respondent can substantiate its answers. Furthermore, the interviewer can ask follow-up questions (e.g. ask for additional explanation) if necessary. This leads to a high level of validity. The findings from the interviews will be used to confirm and/or complement the findings from the quantitative analysis (Small, 2011). The use of qualitative data as an additional source of information makes it possible to make conclusions that go beyond the results of the survey. By conducting interviews, a better understanding of why hypotheses are confirmed or rejected can be gained. The qualitative data provide additional context for the findings from the quantitative analysis.

This research is explanatory, because the main goal is to explain why some firms introduce more product innovations than others. This is done by investigating the proposed causal relationship between firm independence and product innovation. The results from the analyses will be used to check whether the proposed hypotheses can be confirmed and whether the conceptual model is a good representation of reality (Vennix, 2009).

3.3. Data set and data collection

This research uses both quantitative and qualitative data, which will be combined to make conclusions about the predictions made in the previous chapter. The creation of the data sets is addressed below.

The data set for the quantitative analysis consists of around 350 firm establishments located in the Netherlands that operate in the manufacturing industry. The data come from the 2009 European Manufacturing Survey (EMS) titled “Modernisation of Production”. This survey was originally developed by the Fraunhofer Institute for Systems and Innovation Research (ISI) in 1993 (Fraunhofer ISI, n.d.). Since 2001, the EMS survey has been carried out by partners from several European (and later also BRIC) countries. The aim of the survey is to collect firm-level data on value creating processes and innovation activities in the manufacturing industry (Lerch, 2014; Nijmegen School of Management, n.d.).

Data from the Dutch 2009 EMS survey were collected in the Netherlands. The survey was sent by mail to almost 10.000 firm establishments in the manufacturing industry. The minimum number of employees for firms participating in the Dutch EMS survey was 10. Two weeks after the surveys had been sent, reminders were sent by mail. Data from the Dutch survey were collected by Dr. P.M.M. Vaessen and Dr. P.E.M. Ligthart from the Institute for Management Research of the Radboud University Nijmegen.

The 2009 EMS survey contains a large number of variables. For this research, a selection of variables will be made that are relevant for testing the hypotheses and the conceptual model.

Researchers often use a data sample from which they collect data, because usually it is not possible to try and collect data from all members of a certain population (Field, 2009). However, for the collection of the quantitative data of this research no sampling was used. The survey was sent to all firm establishments within the population of firm establishments located in the Netherlands that operate in the manufacturing industry and have a minimum of 10 employees.

The qualitative data for this thesis comes from three semi-structured interviews. Each one will be conducted at a different Dutch manufacturing firm that was acquired by another firm in recent years. The reason for selecting recently acquired firms is that this makes it possible to identify differences between being independent and not being independent in terms of product innovation within one and the same firm. The interviews will be held with employees that have sufficient knowledge about the developments and status quo of their firm in terms of product innovations and autonomy. Two of the firm establishments for the interview were found by conducting internet searches on acquisitions within the Dutch manufacturing industry in recent years. One of the firm establishments was found by contacting an acquaintance who works at that firm. After checking whether the firms that were found met the requirements for being part of this research, the firms were approached by phone to ask if someone with knowledge about the firm's innovation would be willing to participate in an interview.

The unit of analysis for this research is a firm establishment located in the Netherlands operating in the manufacturing industry that has at least 10 employees. The respondents of the EMS survey are managers working at the respective firm establishments. The persons that will be interviewed are R&D managers and/or directors of the firm establishment to which the interview questions refer and are directly involved in the firm establishment's activities and/or decision-making regarding product innovation. These employees are the units of observation of this research; they are the source of the data. In this research, the unit of analysis is at a higher level of aggregation than the unit of observation (Vennix, 2009). Since the respondents are employees at the firm establishments, it is expected that they have sufficient knowledge of their firms to answer all the survey and interview questions in a correct manner. The difference in level of aggregation is therefore not expected to affect the reliability of the data.

3.4. Operationalization

Now that the data sets and data collection methods have been established, the next step is to determine how the concepts in the conceptual model will be measured.

To operationalize the variables that are used in the quantitative analysis, relevant indicators from the EMS survey are selected. Besides the independent, dependent and moderator variables, there are control variables that should be included into the analysis. These variables might affect the dependent variables

in the conceptual model (Figure 2.1) and therefore they should be accounted for. The operationalization of the variables in model A is somewhat different from that of the variables in model B. Where necessary, the variables of each model are addressed separately.

3.4.1. Independent variables

The independent variable for model A (Figure 2.1) is 'Firm establishment independence'. This variable measures the type of firm establishment and is used to determine whether it is independent or not. In the survey question about firm establishment type (Appendix C, question 0.1), there are five types from which respondents have to choose one: HQ of a group with foreign subsidiaries, HQ of a group with only domestic subsidiaries, subsidiary of a group with foreign establishments, subsidiary of a group with only domestic establishments, or independent firm. From these five possible answers, three categories of firm establishments are derived: HQ, stand-alone firm, and subsidiary. These categories make it possible to identify whether a firm is independent or not. As stated in the previous chapter, stand-alone firms and HQ's are both considered to be independent, whereas subsidiaries are not.

For Model B (Figure 2.1), the independent variable is also 'Firm establishment independence'. For this variable, the same survey question – about the type of firm establishment – is used as for model A. Furthermore, the same three categories (HQ, independent stand-alone firm, and subsidiary) are derived from this question. These categories are used to determine whether a firm establishment is independent and also whether a firm establishment belongs to a group. HQ's and subsidiaries are both considered as group firms, as opposed to stand-alone firms, which are independent.

3.4.2. Moderator variable

A moderator variable is a variable that influences a relationship between two other variables (Field, 2009). Model A and B both use the same moderator variable, which is 'Firm youthfulness'. It is measured by looking at the year of foundation or – if applicable – the year of registration at the Dutch Chamber of Commerce (KVK) of the firm establishment (Appendix C, question 13.1). Since the survey was conducted in 2009, the answer '2009' would mean that a firm establishment is less than one year old. When the answer is deducted from 2009, it represents the firm age in full years. The youthfulness variable is used to see if it interacts with the relationship between firm establishment independence and product innovation.

3.4.3. Dependent variables

'Product innovation' is the dependent variable of model A. It is measured with the survey question on whether a firm establishment has introduced any new products or radically improved products during the last three years (Appendix C, question 5.1). Minor improvements in existing products are excluded. This question can be answered with 'yes' or 'no'. The answer is used to establish whether a firm has introduced product innovations.

The dependent variable of model B is 'product innovation (newness)'. This variable is different from that of model A. The variable of model B has three possible categories: no innovations, only new-to-the-firm innovations, or new-to-the-market innovations. Since model B aims to separate firms that have only introduced NTTF innovations from those that have introduced NTTM innovations, a combination of two questions will be used to operationalize this variable. The first question asks whether the firm establishment has introduced any new or radically improved products in the last three years (Appendix C, question 5.1). If the answer is 'yes', it means that the firm establishment has introduced product innovations. If the answer is 'no', the firm has not introduced any product innovations. If the answer to the aforementioned question is 'yes', it is not clear yet if there were any NTTM innovations among these innovations. That is where the second question comes in. This question asks if there were product innovations that were not just new to the respondent's firm, but new to the market (Appendix C, question 5.2). If the answer to both questions is 'yes', it means that the firm establishment has introduced innovations that were NTTM. If the answer to the first question is 'yes' but the answer to the second question is 'no', it means that the firm establishment has only introduced NTTF innovations. For respondents that answer the first question with 'no', the answer to the second question is irrelevant. After all, if the firm has not introduced any product innovations, there cannot be any NTTM product innovations. So, if the answer to the first question is 'no', the firm belongs to the category of no innovations. If the question to the first question is 'yes' but to the second one is 'no', the firm has only NTTF innovations. If the answer to both questions is 'yes', the firm establishment has introduced NTTM innovations.

3.4.4. Control variables

Firm size is the first control variable. It applies to both models. Bigger firms possess more resources and knowledge, which they can use to develop innovations. On the other hand, smaller firms are more flexible, which makes implementing new innovations easier (Damanpour & Wischnevsky, 2006). Therefore, firm size should be controlled for when doing research on innovation. This variable is measured by the total number of employees at the firm establishment (Appendix C, question 13.1).

The second control variable is the percentage of employees in a firm establishment that work in R&D (Appendix C, question 9.2), which is also used in both models. This variable is (somewhat) related to the previous control variable. R&D expenditures and skilled labor can have a positive effect on innovation (Acs & Audretsch, 1988). The higher the percentage of employees that execute R&D activities, the more attention and funds go to innovative activities. Therefore, firms with a high percentage of employees active in R&D are expected to be more innovative than those with a lower percentage.

The industry in which a firm operates can also have an influence on innovation. After all, in some industries innovation might be more important for survival and firms might generally be more innovative

compared to other industries. The characteristics of a firm's industry can have a significant effect on innovation (Becheikh et. al., 2006). Therefore, it should be taken into account. Industry is included in both models as a control variable. It is measured with a question about the type of industry the respondent's firm establishment operates in (Appendix C, question 11.1).

As explained in the previous chapter, technological innovation can be divided into process innovation and product innovation. Even though these two types of innovation follow distinct processes and can have different determinants, it is thought that a link does exist between product and process innovation (Becheikh et. al., 2006). Therefore, when doing research on product innovation, process innovation should be included as a control variable. A list of 13 types of process innovations with corresponding 'yes/no' options is used to measure the process innovations in a firm establishment (Appendix C, question 2.1). For every 'yes' the respondent receives a score of 1, and for every 'no' a score of 0. The total sum of these 13 scores represents the number of process innovations used in that firm establishment. The higher the total score, the more process innovations a firm has implemented.

Multinationality will be included into both models as a control variable. In general, multinational firms are thought to perform better in terms of innovation compared to domestic firms (Frenz & Ietto-Gillies, 2007). Firm establishments that belong to an MNE are thought to have better access to knowledge in other markets and/or countries, which could be beneficial for adopting or generating innovation. Multinationality is measured by looking at firm type (Appendix C, question 0.1). Headquarters of a group with foreign subsidiaries and subsidiaries of a group with foreign subsidiaries are labeled as multinationals. Headquarters of a group with only domestic subsidiaries, subsidiaries of a group with only domestic subsidiaries and independent stand-alone firms are considered not to be multinationals.

The final control variable is firm age, which is measured in the same way as the moderator variable (Appendix C, question 13.1). It is used in both models. The age of a firm can influence its amount of innovation. After all, as firms get older, their knowledge and experience increase. On the other hand, it becomes more difficult for them to change their established routines and procedures (Becheikh et al., 2006; Damanpour & Wischnevsky, 2006). Even though it is not clear if firm age has a positive or a negative impact on innovation, the variable should be included in the model to control for its possible effect. Furthermore, in order to analyze the moderating effect of firm youthfulness, the variable should also be included in the analyses as a separate variable.

Appendix B contains the operationalization table of the variables in the quantitative analysis.

3.4.5. SPSS analysis

As stated above, a quantitative analysis will be conducted using data from a survey in the form of a written questionnaire. The analysis is done using the software package SPSS Statistics.

To analyze the relevant data from the EMS survey, regression analysis will be used. Regression is a dependence technique that uses one or more independent variables to predict the value of a single dependent variable, by fitting a model to the data (Hair, 2014; Field, 2009). The results of the regression analysis explain the relationships between the independent variable(s) and the dependent variable. The type of regression that will be used to analyze the data is logistic regression. In this method, one or more independent variables are used to predict and explain a dependent variable. The dependent variable has to be categorical; the independent variable(s) can be either metric or nonmetric. In contrast to linear regression, logistic regression does not require any specific distribution of the independent variable(s). Furthermore, a linear relationship between the independent and the dependent variable is not required, as long as the independent variable is non-metric (Field, 2009; Hair, 2014).

In model A (Figure 2.1), the independent variable is categorical and therefore non-metric. The dependent variable is binary. For this model, a binary logistic regression analysis should be conducted. For model B (Figure 2.1), the independent variable is the same as for model A and thus also categorical. However, the dependent variable in model B is categorical but not binary, because it has more than two categories. Therefore, multinomial logistic regression analysis should be used here. This type of logistic regression should be conducted when the dependent variable is categorical and has more than two categories (Field, 2009).

Since the aim of this thesis is to measure the impact of firm establishment independence and group membership on product innovation, logistic regression is an appropriate method to apply. For model A, binary logistic regression is used to find out whether firm independence is a good predictor for product innovation. For model B, multinomial logistic regression is used to see whether firm independence is a good predictor for NTTM product innovation and whether group membership is a good predictor for NTTF innovation.

3.4.6. Qualitative analysis

In order to collect, process and interpret the data from the interviews, several steps have to be taken. Prior to conducting the interviews, an interview script is drawn up. This script contains an introduction about the goal of this research, a list of questions which are divided into subjects, and some closing remarks. Appendix A contains the interview script for this research.

The interviews are semi-structured. This means that the questions asked are mostly predetermined, as well as the order in which they are asked. As such, the interviewer has sufficient guidance, but can bring some variation into the interview and/or use follow-up questions if necessary. The use of predetermined questions increases reliability. Furthermore, it ensures that no subjects are skipped. The interview questions are open-ended, which gives respondents the opportunity to choose their own wordings and can elaborate on their answers. (Bleijenbergh, 2013; Vennix, 2009).

The interviews will be recorded, for which prior permission is asked. These recordings will be used to transcribe the interviews. The transcription texts are then used to code the interviews with terms that correspond to the concepts and relationships as described in the theoretical framework (Bleijenbergh, 2013; Vennix, 2009).

3.5. Validity and reliability

In order to keep the degree of measurement error of the values used in this research to a minimum level, validity and reliability of the values should be assessed. Validity represents the amount of accuracy and correctness of a measure. If a measure is valid, it is measuring that which it is supposed to measure. Put differently, validity is about asking the correct questions (Hair, 2014). Reliability on the other hand refers to the degree of consistency of a measure. A reliable measure should give the same outcomes (more or less) when it is used repeatedly under the same conditions. High levels of validity and reliability lead to a good and precise representation of the measures used in the analysis, which ultimately increases the power and quality of the research outcomes (Hair, 2014).

The variables used in the quantitative research are based on the findings from theory and empirical studies as discussed in Chapter 2. This improves the accuracy of the measures and therefore increases validity. The use of control variables also enhances validity, because it decreases the chance that any effects measured are caused by other variables than the independent variable. Furthermore, validity is ensured by using an extensive and detailed survey, treating all relevant subjects.

Nearly all the EMS survey questions used in this research are closed-ended questions and the various answer options are clearly distinguishable from one another. Furthermore, the survey questions are precisely and carefully formulated by professional researchers. As a result, this research is not expected to have any issues in terms of reliability. The fact that a very large number of firm establishments has been approached to fill in the EMS survey improves the generalizability (i.e. external validity) of this research. The generalizability of the outcomes of the logistic regression can be checked by using a holdout sample or by cross-validation (Hair, 2014).

For the qualitative data, reliability is ensured through the use of an interview script with predetermined subjects and corresponding questions. By using such a script, in each interview the same questions are asked and similar phrasing is used. The fact that the topics and questions in the interviews are based on existing theory and empirical evidence improves the validity of the data. Validity is also ensured by using open-ended questions. This gives respondents the opportunity to give precisely formulated answers, as opposed to being bound to a limited set of predetermined answers.

The combination of quantitative and qualitative data in this research improves the validity of the outcomes. After all, the proposed relationships between the concepts are tested using two different approaches. This way, the results are based on multiple perspectives, preventing a one-sided view on

the subject at hand. The quantitative and qualitative analyses both use the same concepts, which are based on existing theory and empirical evidence. This provides consistency of the outcomes. Furthermore, for both types of analysis the unit of analysis is the same and the respondents have similar characteristics.

3.6. Research ethics

In order to conduct research in a correct and professional manner and to respect and protect the interest of those involved, researchers should act with integrity and in an ethical manner. In the context of this thesis, the following remarks can be made about research ethics.

All the data used in this research are anonymized and are treated with the necessary amount of confidentiality. This way, any sensitive data and corresponding interests of the firms and respondents are protected. The respondents have been made aware of the fact that the data will be used for research purposes. In return for their cooperation, firm establishments participating in the survey were given the possibility to request a benchmark report free of charge. Firm establishments participating in the interviews will receive a copy of this thesis. The interview respondents were given the opportunity to check and (if necessary) make comments on the interview transcripts.

This research aims to achieve full transparency by documenting the processing of data and presenting the research methods and outcomes in a clear and correct manner. The interview recordings and transcripts will only be distributed to the supervisors. The supervisors and the firm establishments participating in the interviews will receive a copy of this thesis. Furthermore, a copy of this thesis will be available for viewing at the library of the Nijmegen School of Management. Apart from that, no copies and/or results will be distributed to any other party.

In Appendix F, a signed research integrity form can be found.

Chapter 4 – Results

4.1. Introduction

In the previous chapters, the research questions, theoretical framework, hypotheses and research methodology were presented. In order to test the hypotheses and answer the research questions, in this chapter quantitative and qualitative analyses will be conducted. First, characteristics of the data and the construction of variables will be discussed. Then, the assumptions for the logistic regression analysis will be checked. Following the assumptions, a binary logistic regression is conducted, followed by a multinomial logistic regression. After the quantitative analyses, a qualitative analysis is done. Finally, conclusions will be drawn on the results of all analyses combined.

4.2. Response

For the quantitative analyses, data from the European Manufacturing Survey 2009 (EMS) were used. This survey was sent to approximately 10.000 firm establishments. Of those 10.000 establishments, 331 responded to the request to fill in and send back the survey. This means that the response rate for the EMS survey was around 3.3 percent. This percentage is quite low and therefore should be taken into account when interpreting the results.

For the qualitative analysis, several firms in the manufacturing industry that were acquired in recent years were contacted by phone. Three firms were willing to participate in an interview. The interviews were conducted with R&D managers and executives of the respective firms. Each of the firm establishments that took part in an interview operates in a different industry sector.

4.3. Construction of variables

In Chapter 3, the operationalization of the variables used in the quantitative analyses was presented. Some of the variables used in the analyses are created or adapted from the original items in the EMS survey. The process of creating and adapting these variables will be discussed below.

“Product innovation (newness)” was created by combining a binary variable on new products and a binary variable on new-to-the-market products. It has three values: 0 for no innovations, 1 for only new-to-the-firm innovations, and 2 for new-to-the-market innovations. “Firm age” is measured by the age of a firm establishment in years. The variable was computed by deducting the year of establishment from the year the survey was conducted (2009). It reflects the youthfulness of a firm: the younger the firm establishment, the higher its youthfulness. “Multinationality” is a binary variable which was created by recoding a variable on firm establishment type. A value of 1 means that the firm establishment is part of a multinational group, whilst a value of 0 indicates that the establishment is part of a domestic group or does not belong to any group. “Process innovation” was created by recoding 13 binary variables into a new (metric) variable. Each positive score on a binary variable corresponds to a value of 1. The total

number of positive scores from the binary variables corresponds to the types of process innovations the firm establishment has introduced. The minimum value of the created variable is 0 and the maximum value is 13. Appendix B contains the operationalization table of all the variables in the quantitative analyses. Since SPSS automatically creates dummy variables from categorical variables with more than two categories when conducting logistic regression, no manual creation of dummy variables is required.

4.4. Characteristics of data

Before conducting the main analyses of this research, relevant characteristics of the quantitative and qualitative data are discussed. First, the quantitative data are explored. Then, some characteristics of the qualitative data are presented.

4.4.1. Quantitative data

The first step to exploring the data of the EMS survey is to conduct univariate analyses on the variables that will be used in the multivariate analyses later on. The univariate analyses can give valuable insights in the characteristics of the variables in this research. Appendix D contains the output of these analyses.

For all categorical variables, the proportion of valid responses is very high. The number of valid responses ranges from 326 to 331, with a total number of respondents of 331. This means that there are almost no missing cases among the categorical variables. The sample contains 182 stand-alone firm establishments, 86 subsidiaries and 59 HQ's. About half (50.2%) of the firm establishments has introduced new products in the last three years. Of the firms that have introduced product innovations, 59.6% (99/166) has introduced products that were new to the market. The firm establishments are divided into eight industry sectors. The majority of the firm establishments is active in the Metals (21.8%), Machinery (19.0%) or Construction (16.6%) industry sector. Most firm establishments are not part of a multinational group (70.6%). Table 4.1 shows all frequencies and percentages.

Table 4.1 – Characteristics of categorical variables

Determinant	Description	N (valid)	Frequency (valid %)
Firm independence	Type of firm establishment	327	
Subsidiary		86	26.3
Stand-alone		182	55.7
HQ		59	18.0
Product innovation	Introduction of new product(s) in past three years	331	
Yes		166	50.2
No		165	49.8
Product innovation (newness)	Introduction of products new to the market or only new to the firm	331	
NTTM innovations		99	29.9
Only NTTF innovations		67	20.2
No innovations		165	49.8
Industry	Type of industry	326	
Metals		71	21.8
Food		34	10.4
Textiles		24	7.4

Construction		54	16.6
Chemicals		46	14.1
Machinery		62	19.0
Electronics		24	7.4
Transport		11	3.4
Multinationality	Part of group with foreign establishments	327	
Multinational		96	29.4
Domestic		231	70.6

The number of valid responses on the continuous variables is also very high (between 321 and 331), except for the variable 'Firm age', which is lower but still acceptable (255). The average age of the firm establishments is around 37 years, the oldest one being 173 years and the youngest 1 year. The average number of process innovations that were introduced is 2, with a maximum of 12. The share of personnel that works in R&D ranges from 0% to as high as 70%, with a mean of 5.80%. The average firm size is 64 employees. The minimum firm size is 10, which corresponds to the objectives of the EMS survey. The largest firm establishment in the sample has 3000 employees.

Table 4.2 – Characteristics of metric variables

Determinant	Description	N (valid)	Min	Max	Mean	S.D.	Skewness	Kurtosis
Firm age	Age of the firm in years	255	1	173	37.19	30.66	1.61	2.90
Process innovation(s)	Number of process innovations	321	0	12	2.05	1.99	1.44	3.28
Personnel in R&D	% of employees working in R&D	323	0	70	5.80	8.10	3.30	16.97
Firm size	Number of employees in 2008	331	10	3000	63.90	177.89	13.96	226.58

Unlike linear regression, logistic regression does not have to meet the assumption of normality (Hair, 2014; Field, 2009). However, since the metric variables "Share of personnel in R&D" and "Firm size" have very high values of skewness and/or kurtosis, it is wise to check if they might negatively influence the outcomes of the logistic regression. In order to see if this is the case, a Mann-Whitney test is conducted with these variables and its results are compared to the results of a binary logistic regression with the same variables. A Kruskal-Wallis test is used in the same way for comparison with a multinomial regression.

The Mann-Whitney test shows that firm establishments which introduced product innovations in the last three years were significantly bigger in size ($p < 0.01$) and have a significantly higher share of personnel in R&D ($p < 0.01$) than firm establishments that did not introduce product innovations. The Kruskal-Wallis test shows a significant relationship between "Product innovation (newness)" and "Firm size" ($p < 0.01$) and between "Product innovation (newness)" and "Share of personnel in R&D" ($p < 0.01$). The binary logistic regression results show that share of personnel in R&D has a significant impact on product innovation ($p < 0.01$), but firm size does not ($p > 0.1$). The multinomial regression shows the

same when it comes to the impact on "Product innovation (newness)": share of personnel in R&D is significant ($p < 0.01$) whereas firm size is not ($p > 0.1$). This means that the high levels of skewness and/or kurtosis of "Firm size" appear to affect its scores in a logistic regression. Therefore, this variable is transformed using a log transformation.

The transformed variable "Ln Firm size" has much better scores on skewness and kurtosis (Table 4.3). Furthermore, the variable is significant in the Mann-Whitney ($p < 0.01$) and Kruskal-Wallis ($p < 0.01$) test as well as in the binary ($p < 0.05$) and multinomial logistic regression ($p < 0.05$) analyses.

Table 4.3 – Characteristics of transformed metric variable

Determinant	Description	N (valid)	Min	Max	Mean	S.D.	Skewness	Kurtosis
Ln Firm size	Number of employees in 2008	331	2.30	8.01	3.57	0.89	1.07	1.69

4.4.2. Qualitative data

For the qualitative analysis, interviews were conducted at three different firm establishment that operate in the Dutch manufacturing industry and were acquired by another firm in recent years. One interview was conducted at each firm. The respondent of Firm A is Lead Engineer R&D, the respondent of Firm B is Commercial Director and member of the board, and the respondent of Firm C is Principal Engineer and co-founder. Table 4.4 shows some relevant characteristics of these firms.

Table 4.4 – Characteristics of interviewed respondents' firms

	Firm A	Firm B	Firm C
Industry	Sorting machines	Food packaging	Laser scanners
Age	7 years	40 years	7 years
Acquired	July 2016	May 2016	October 2016
Size at acquisition	28 employees	38 employees	7 employees
Size now	36 employees	45 employees	12 employees
Size of acquirer	900 employees	600 employees	38000 employees
Personnel in R&D at acquisition	2 FTE	0 FTE	5 FTE
Personnel in R&D now	2.5 FTE	0 FTE	10 FTE

4.5. Logistic regression analyses

In this paragraph, quantitative analyses will be conducted to test the relationships between the variables. First, the assumptions of the analyses will be tested. Then, the binary logistic regression is conducted. After that, the multinomial logistic regression is conducted. The paragraph finishes with a conclusion on the findings from the quantitative analyses.

4.5.1. Assumptions of logistic regression

So far, the characteristics of the data and variables have been established and evaluated. The next step is to analyze the hypothesized relationships between these variables. The quantitative part of this

analyses is done by conducting two logistic regressions. The first step in conducting these analyses is to see what the assumptions of logistic regression are and whether they are met. Hair (2014) states that there is a general lack of assumptions in logistic regression. The independent variables do not require a specific distributional form, heteroscedasticity does not play a role, and linear relationships between independent and dependent variables are not necessary. According to Field (2009) however, logistic regression should still meet the following assumptions: linearity of continuous independent variables with the log transformation of the dependent variable, independence of errors and no multicollinearity. These assumptions will now be checked for both the binary and the multinomial regression analysis. The output of these checks can be found in Appendix D.

The assumption of linearity can be tested by running a regression analysis with the continuous independent variables and interaction terms of those variables and their log transformations (Field, 2009). Even though the continuous variables in this research only serve as control variables, SPSS treats them as independent variables and therefore they should be tested. The log interactions of "process innovation", "Ln firm size" and "Share of personnel in R&D" are not significant at the .05 level, which means they meet the linearity assumption. The log interaction of "Firm age" is significant ($p < 0.01$) and therefore does not meet this assumption. Several transformations were attempted, but none of them resulted in an insignificant log interaction. This variable will not be transformed into a categorical variable, because it would cause a significant loss of information. The coefficient of this particular (control) variable should be interpreted with some caution (Hosmer & Lemeshow, 2000).

To test if there is no multicollinearity, a linear regression with all variables is conducted to get the Collinearity Statistics. Tolerance values should be higher than 0.02, whilst VIF scores should be below 10 (Field, 2009). The results of the regression show that there is no multicollinearity (Tolerance between 0.627 and 0.892, VIF between 1.071 and 1.594). The scores are the same for binary and multinomial model. This means that the assumption is met for both types of analysis.

The assumption of independence of errors means that cases of data should be unrelated (Field, 2009). To test this assumption, a Durbin-Watson test is conducted using a linear regression analysis with all variables. The value of this test should be between 1 and 3, with an ideal value of 2. The value for the binary logistic regression is 2.021 and for the multinomial logistic regression is 1.966. This shows that there is independence of errors. Another way to ensure independence of errors is to check for overdispersion. The ratio of the Chi-square goodness-of-fit statistic to its degrees of freedom is (229.596 / 218 = 1.053) for the binary logistic regression and (448.055 / 436 = 1.028) for the multinomial logistic regression. Since these values are only slightly greater than 1, there is no reason to suspect any overdispersion (Field, 2009). This confirms that there is indeed independence of errors.

4.5.2. Binary logistic regression

Now that the assumptions have been tested, the first logistic regression analysis can be executed. This is a binary logistic regression, which corresponds to Model A of the conceptual model and Hypotheses 1a, 1b, 2a and 2b. The output of this analysis can be found in Appendix D. The variables are entered into the model in three steps. The first model contains only the control variables. The second model contains the control variables and the independent variable "Firm independence". The third model also includes the interaction term of "Firm independence" and "Firm age", which represents the moderator variable. Since interpreting an independent variable can be problematic when the model also contains an interaction term with that variable, Model 2 will be used for the interpretation of the impact of "Firm independence" on "Product innovation", as well as for the effect of the control variable "Firm age".

Table 4.5 – Model fit for binary logistic regression

Model	Exp.(B)	Sig.	-2 LL	Chi-square	df	Sig.	Cox & Snell R^2	Nagelkerke R^2
Model 0[a]	1.071	.896	327.149					
Model 1[b]			288.360	38.789	12	.000	.152	.202
Model 2[c]			287.852	39.296	14	.000	.153	.205
Model 3[d]			276.164	50.985	16	.000	.194	.259

[a] = Null model
[b] = Entered control variables: Industry, Multinationality, Firm age, Ln Firm size, Personnel in R&D, Process innovation
[c] = Entered independent variable: Firm independence
[d] = Entered interaction term: Firm independence * Firm age

Model 0 is the null model, with no independent variables to predict the dependent variable. The odds ratio (Exp.(B)) is close to 1 (OR = 1.071) and not significant ($p > 0.1$), which indicates that the likelihood of introducing product innovation is close to 50%. This is in line with the characteristics of the dependent variable "Product innovation" (Table 4.1).

In Model 1, the control variables are added into the logistic regression. The value of the -2 log likelihood for Model 1 (-2 LL = 288.360) is lower than the value for Model 0 (-2 LL = 327.149), which means that Model 1 is better at predicting the dependent variable than Model 0. The Chi-square statistic of Model 1 is significant (Chi-square = 38.789, $p < 0.01$), which means that there is a significant amount of predictive power. The predictive power of Model 1 can be assessed by looking at the values of Cox & Snell's R^2 and Nagelkerke's R^2 (Field, 2009). The amount of variation accounted for by the model lies between 15.2% (Cox & Snell's $R^2 = 0.152$) and 20.2% (Nagelkerke's $R^2 = 0.202$). The percentage of outcomes predicted correctly by the model increases from 50.4% to 64.4%.

Model 2 contains the control variables and the independent variable "Firm independence". The -2 LL value of this model (-2 LL: 287.852) is (slightly) lower than that of Model 1, indicating an increase in predictive power. The model has a significant Chi-square statistic (Chi-square = 39.296, $p < 0.01$) and its value is higher than the previous model. The amount of explained variation lies between 15.3% (Cox

& Snell's R^2 = 0.153) and 20.5% (Nagelkerke's R^2 = 0.205). The percentage of correctly predicted outcomes is 64.8%, which is 0.4% higher than Model 1. Even though the increase in Chi-square is not significant (p > 0.1), all other values have improved., indicating an overall improvement of the model.

Model 3 includes the interaction term between the independent variable and the moderator variable. The addition of this term decreases the -2 LL value (-2 LL = 276.164), indicating an increase in predictive power. The Chi-square is significant (Chi-square = 50.985, p < 0.01). The increase of the Chi-square is 11.688 and this increase in predictive power is significant (p < 0.05). The predictive power of Model 3 is higher than for Model 2: between 19.4% (Cox & Snell's R^2 = 0.194) and 25.9% (Nagelkerke's R^2 = 0.259) of the variation is accounted for. The percentage of correctly predicted outcomes increases with 0.5% to 65.3%. So, compared to the null model, the percentage of correctly predicted outcomes by Model 3 is 14.9% higher.

Table 4.6 – Results of binary logistic regression (Model 2 and 3)

Determinant	B	Exp.(B)	B	Exp.(B)
	Model 2 (main effect)		Model 3 (interaction)	
Firm independence [a]				
Stand-alone	.072	1.074	-1.187*	.305
HQ	-.259	.772	.171	1.187
Firm independence * Firm age [a]				
Stand-alone * Firm age			**.030*** **	1.030
HQ * Firm age			-.014	.987
Industry [b]				
Metals	-.681	.506	-.616	.540
Food	.101	1.106	.339	1.403
Textiles	-.479	.619	-.169	.845
Construction	-.263	.768	-.115	.892
Chemicals	.082	1.085	.043	1.044
Machinery	-.316	.729	-.170	.843
Electronics	-.081	.923	.068	1.070
Multinationality [c]				
Multinational	-.088	.916	-.286	.751
Firm age	-.004	.996	-.017*	.984
Ln size	.456**	1.578	**.498****	1.646
Personnel in R&D	.110***	1.116	**.122*****	1.129
Process innovation	.071	1.073	.084	1.088

Significance level *p<0.1; **p<0.05; ***p<0.01
[a] Reference category: Subsidiary
[b] Reference category: Transport
[c] Reference category: Domestic

The results of Model 2 (main effects) show that there is no significant difference between stand-alone firm establishments and subsidiaries in terms of the likelihood of introducing product innovations (B = 0.072, p > 0.1). Stand-alone firms are not more likely to introduce product innovations than subsidiaries. As a result, Hypothesis 1a is rejected.[1] There is no significant difference between HQ firm

[1] H1a: Stand-alone firm establishments are more likely to introduce product innovations than subsidiary firm establishments.

establishments and subsidiaries either (B = -0.259, p > 0.1). Hypothesis 1b is also rejected.[2] The rejection of these hypotheses indicates that firm independence does not have a positive impact on the likelihood to introduce product innovations.

For the interpretation of the moderator variable ("Firm age"), Model 3 is used. The interaction term between "Firm independence" and "Firm age" is significant when stand-alone firm establishments are compared to subsidiaries (B = 0.030, p < 0.01). As the age of a firm increases, the likelihood of stand-alone firm establishments to introduce product innovations seems to increase, compared to that of subsidiaries (OR = 1.030). This means that as stand-alone firm establishments are younger, their likelihood to introduce product innovations decreases compared to that of subsidiaries. This effect is opposite from what was hypothesized. As a result, Hypothesis 2a is rejected.[3] Furthermore, there is no significant difference between HQ's and subsidiaries in combination with "Firm age" (B = -0.014, p > 0.1). This means that Hypothesis 2b is rejected.[4] The rejection of the aforementioned two hypotheses shows that not being independent is not worse for younger firm establishments than for older ones, in terms of likelihood to introduce product innovations. In fact, subsidiaries even appear to perform better than stand-alone firms as the age of the firms decreases.

Inspection of the control variables shows that "Industry", "Multinationality" and "Firm age" are not significant. "Ln Firm size" (B = 0.498, p < 0.05) and "Share of personnel in R&D" (B = 0.122, p < 0.01) are both significant, indicating that more employees and a higher percentage of employees in R&D both lead to a higher likelihood of introducing product innovations.

4.5.3. Multinomial logistic regression

The second logistic regression of this research is a multinomial regression. This analysis is used to test the impact of firm independence on NTTM product innovation and the impact of firm independence and group membership on NTTF product innovation. The multinomial logistic regression corresponds to Model B of the conceptual model and Hypotheses 3a, 3b, 3c, 4a, 4b, 4c, 5a, 5b, 6a and 6b. The output of the analysis can be found in Appendix D.

[2] H1b: HQ firm establishments are more likely to introduce product innovations than subsidiary firm establishments.
[3] H2a: The younger firm establishments are, the more likely stand-alone firm establishments are to introduce product innovations compared to subsidiary firm establishments.
[4] H2b: The younger firm establishments are, the more likely HQ firm establishments are to introduce product innovations compared to subsidiary firm establishments.

Table 4.7 – Model fit for multinomial logistic regression

Model	-2 LL	Chi-square	df	Sig.	Cox & Snell R^2	Nagelkerke R^2	AIC
Model 0[a]	485.440						489.440
Model 1[b]	426.653	58.787	24	.000	.220	.253	478.653
Model 2[c]	421.945	63.494	28	.000	.236	.270	481.945
Model 3[d]	409.582	75.858	32	.000	.275	.315	477.582

[a] = Null model
[b] = Entered control variables: Industry, Multinationality, Firm age, Firm size (Ln), Share of personnel in R&D, Process innovation
[c] = Entered independent variable: Firm independence
[d] = Entered interaction term: Firm independence * Firm age

First, a multinomial regression is conducted containing only the control variables. Model 1 shows that the -2 LL value (-2LL = 426.653) is lower than Model 0 (-2LL = 485.440), which means there is an increase in predictive power compared to the null model. The Chi-square statistic (Chi-square = 58.787) is significant ($p < 0.01$), indicating that the predictive power is significantly better than the null model. The amount of explained variation of Model 1 lies between 22% (Cox & Snell's $R^2 = .220$) and 25.3% (Nagelkerke's $R^2 = .253$). The goodness-of-fit statistics are both not significant (Pearson = 461.859, $p > 0.1$; Deviance = 425.267, $p > 0.1$), indicating that the model is a good fit of the data. Akaike's Information Criterion of Model 1 (AIC = 478.653) is lower than the null model (AIC = 489.440), showing that the model fit is increased (Table 4.7).

Model 2 is a multinomial regression with the control variables and the independent variable. The -2 LL value (-2LL = 421.945) is lower than for Model 1, indicating an increase in predictive power. The Chi-square statistic is significant (Chi-square = 63.494, $p < 0.01$) and higher than the value of Model 1, which also points towards increased predictive power. Model 2 has an explained variation between 23.6% (Cox & Snell's $R^2 = .236$) and 27% (Nagelkerke's $R^2 = .270$); an increase compared to Model 1. Both of the goodness-of-fit statistics are not significant (Pearson = 457.681, $p > 0.1$; Deviance = 420.559, $p > 0.1$), which means that Model 2 fits the data well. Even though the AIC is slightly higher (AIC = 481.945) than the AIC of Model 1, the value is still considerably lower than the AIC of Model 0. Furthermore, all the other model fit tests indicate an improvement compared to Model 1.

Model 3 contains the control variables, the independent variable and the interaction term between the independent and moderator variable. The -2LL value (-2LL = 409.582) is lower than for Model 2, indicating an increase in predictive power. The Chi-square statistic is significant (Chi-square = 75.858, $p < 0.01$), so there is a significant amount of predictive power. Furthermore, the Chi-square is higher than that of model 2, indicating an increase in predictive power. The proportion of explained variance is between 27.5% (Cox & Snell's $R^2 = 0.275$) and 31.5% (Nagelkerke's $R^2 = 0.315$), an increase of 3.9% - 4.5% compared to Model 2. Both goodness-of-fit statistics are not significant (Pearson = 448.055, $p >$

0.1; Deviance = 408.196, p > 0.1). This means the model is a good fit of the data. The AIC of Model 3 (AIC = 477.582) is lower than all previous models, indicating an increase in model fit (Table 4.7).

Table 4.8 – Results of final multinomial logistic regression model (Model 2)

Determinant	B	Exp.(B)	B	Exp.(B)
NTTM innovation vs. No innovation	**Model 2 (main effect)**		**Model 3 (interaction)**	
Firm independence				
Stand-alone [a]	.835	2.306	-.356	.700
HQ [a]	.196	1.216	.901	2.463
HQ [d]	-.639	.528	1.258	3.571
Firm independence * Firm age [a]				
Stand-alone * Firm age			**.026***	1.027
HQ * Firm age			-.023	.997
Industry [b]				
Metals	-.934	.393	-.838	.432
Food	.342	1.408	.585	1.795
Textiles	-.484	.616	-.152	.859
Construction	-.722	.486	-.594	.552
Chemicals	.404	1.498	.391	1.479
Machinery	-.413	.662	-.207	.813
Electronics	-.482	.618	-.325	.722
Multinationality [c]				
Domestic	-.199	.820	.059	1.061
Firm age	-.003	.997	-.014	.986
Ln size	**.524****	1.689	.560**	1.750
Personnel in R&D	**.123*****	1.131	.135***	1.145
Process	**.212****	1.237	.230**	1.285
Only NTTF innovation vs. No innovation	**Model 2 (main effect)**		**Model 3 (interaction)**	
Firm independence				
HQ [d]	-.061	.941	1.421	4.142
Subsidiary [d]	.651	1.917	2.006**	7.431
HQ [a]	-.712	.491	-.584	.557
Firm independence * Firm age [a]				
Stand-alone * Firm age			**.034****	1.035
HQ * Firm age			-.004	.996
Industry [c]				
Metals	-.426	.653	-.373	.689
Food	-.289	.749	-.014	.986
Textiles	-.488	.614	-.173	.841
Construction	.075	1.078	.253	1.288
Chemicals	-.647	.524	-.722	.486
Machinery	-.283	.754	-.175	.839
Electronics	.292	1.339	.453	1.572
Multinationality [d]				
Domestic	.207	1.230	.346	1.414
Firm age	-.004	.996	.015	1.015
Ln size	.384	1.468	.422	1.525
Personnel in R&D	.090***	1.094	**.102*****	1.107
Process	-.170	.844	-.156	.856

Significance level *p<0.1; **p<0.05; ***p<0.01

[a] Reference category: Subsidiary

[b] Reference category: Transport

[c] Reference category: Multinational

[d] Reference category: Stand-alone

New-to-the-market product innovations

Model 2 of the multinomial regression analysis shows the following effect(s) of "Firm independence" on NTTM product innovations. There is no significant difference in likelihood of introducing such innovations between stand-alone firm establishments and subsidiaries (B = 0.835, p > 0.1) and between HQ's and subsidiaries (B = 0.196, p > 0.1). This means that stand-alone and HQ firm establishments are not more likely to introduce NTTM innovations than subsidiaries. Consequently, Hypotheses 3a and 3b are rejected.[5] The rejection of these hypotheses indicates that there is no impact of firm independence on the likelihood to introduce NTTM product innovations.

There is no significant difference in the likelihood to introduce NTTM product innovations between stand-alone firms and HQ firms (B = -0.639, p > 0.1). This means that when independent group firms (HQ's) are compared to independent non-group firms (stand-alone firms), there is no impact of group membership on the likelihood to introduce NTTM product innovations. This means that Hypothesis 3c is confirmed.[6] As predicted, group membership does not have an effect on NTTM innovation.

The interaction term between "Firm independence" and "Firm age" is marginally significant for stand-alone firm establishments when compared to subsidiaries (B = 0.026, p < 0.1), as can be seen in Model 3. As firm establishments grow older, the likelihood of stand-alone firm establishments to introduce NTTM innovations increases, compared to that of subsidiaries (OR = 1.027). In other words, stand-alone firms become less likely to introduce NTTM innovations compared to subsidiaries when the firm establishments are younger. Since this effect is different from what was hypothesized, Hypothesis 5a is rejected.[7] The interaction term for HQ's compared to subsidiaries is insignificant (B = -0.023, p > 0.1). Therefore, Hypothesis 5b is also rejected.[8] HQ firm establishments do not become more likely to introduce NTTM innovations compared to subsidiaries as they are younger. The aforementioned results indicate that independent firm establishments do not become more likely to introduce new-to-the-market product innovations compared to non-independent firm establishments, the younger they are. As a matter of fact, stand-alone firms become less likely to do so, compared to subsidiaries.

For NTTM innovations, the control variables "Industry", "Multinationality" and "Firm age" are not significant. "Ln firm size" (B = .560, p < 0.05), "Share of personnel in R&D" (B = 0.135, p < 0.01) and "Process innovation" (B = 0.230, p < 0.05) are significant. These variables indicate that firm size, share

[5] H3a: Stand-alone firm establishments are more likely to introduce new-to-the-market product innovations than subsidiary firm establishments.
H3b: HQ firm establishments are more likely to introduce new-to-the-market product innovations than subsidiary firm establishments.
[6] H3c: HQ firm establishments are just as likely to introduce new-to-the-market product innovations as stand-alone firm establishments.
[7] H5a: The younger firm establishments are, the more likely stand-alone firm establishments are to introduce new-to-the-market product innovations compared to subsidiary firm establishments.
[8] H5b: The younger firm establishments are, the more likely HQ firm establishments are to introduce new-to-the-market product innovations compared to subsidiary firm establishments.

of personnel in R&D and process innovations are positively related to the likelihood of introducing NTTM product innovations.

New-to-the-firm product innovations

As for the likelihood to introduce NTTF innovations, there is no significant difference between subsidiaries and stand-alone firm establishments (B = 0.651, p > 0.1). Therefore, Hypothesis 4a is rejected.[9] Furthermore, there is no significant difference between HQ's and stand-alone firm establishments (B = -0.061, p > 0.1). Hypothesis 4b is rejected.[10] These findings show that subsidiaries and HQs are not more likely to introduce new-to-the-firm product innovations than stand-alone firm establishments. Apparently, group membership does not have a positive impact on the likelihood of firms to introduce product innovations. The difference between HQ's and subsidiaries in terms of likelihood of introducing NTTF innovations is not significant (B = -0.712, p > 0.1). This means that Hypothesis 4c is rejected.[11] These results indicate that autonomy does not make HQ firms better at introducing NTTF innovations than subsidiaries.

When looking at the interaction effect of "Firm independence" and "Firm age", the results are as follows. There is a significant effect of stand-alone firm establishments compared to subsidiaries in combination with age (B = 0.034, p < 0.05). As their age increases, the likelihood of stand-alone firm establishments to introduce NTTF innovations increases compared to that of subsidiaries (OR = 1.035). Correspondingly, the likelihood of stand-alone firms to introduce NTTF innovations decreases compared to that of subsidiaries, the younger they are. Since this is opposite from the effect that was hypothesized, Hypothesis 6a is rejected.[12] The difference between HQ's and subsidiaries in combination with firm age is not significant (B = -0.004, p > 0.1), which means that Hypothesis 6b is rejected.[13] The rejection of these two hypotheses indicates that the likelihood of independent firm establishments does not increase compared to non-independent firm establishments, the younger they are. The likelihood of stand-alone firms even decreases compared to that of subsidiaries, as they become younger.

Of the control variables, only "Share of personnel in R&D" is significant (B = 0.102, p < 0.01) for NTTF innovations, indicating a positive impact of the share of personnel in R&D on introducing NTTF product innovations. The other control variables are not significant.

[9] H4a: Subsidiary firm establishments are more likely to introduce new-to-the-firm product innovations than stand-alone firm establishments.
[10] H4b: HQ firm establishments are more likely to introduce new-to-the-firm product innovations than stand-alone firm establishments.
[11] H4c: HQ firm establishments are more likely to introduce new-to-the-firm product innovations than subsidiary firm establishments.
[12] H6a: The younger firm establishments are, the more likely stand-alone firm establishments are to introduce new-to-the-firm product innovations compared to subsidiary firm establishments.
[13] H6b: The younger firm establishments are, the more likely HQ firm establishments are to introduce new-to-the-firm product innovations compared to subsidiary firm establishments.

4.5.4. Conclusion

All in all, the quantitative results indicate that there is no impact of firm independence on (NTTM and NTTF) product innovation. This can be concluded from the rejection of Hypotheses 1a, 1b, 3a, 3b and 4c. So, autonomy does not have a positive effect on a firm's likelihood to introduce product innovations, but it does not have a negative effect either.

Group membership does not have an effect on the likelihood to introduce NTTM and NTTF product innovations. This is shown by the rejection of Hypotheses 4a and 4b and the confirmation of Hypothesis 3c. Apparently, group firms do not profit from the access to intragroup knowledge and resources when it comes to introducing product innovations.

Youthfulness does not have a positive moderating effect on the relationship between firm independence and (NTTM and NTTF) product innovation. This can be concluded from the rejection of Hypotheses 2a, 2b, 5a, 5b, 6a and 6b. The results on the moderating effect of youthfulness show that subsidiaries even perform better in terms of product innovation compared to stand-alone firms, as they become younger. This is opposite from what was expected. The effect could mean that young subsidiaries are better at introducing product innovations than young stand-alone firms, because of group membership-related advantages. However, the fact that in general there is no impact of group membership on product innovation implies that this positive effect is not sustainable as firms become older.

4.6. Qualitative analysis

In order to verify the findings from the quantitative analyses and get a better understanding of the reasons behind the observed relationships, a qualitative analysis is conducted. The qualitative analysis serves as an additional source of data, next to the quantitative results. The analysis uses three interviews, which have been transcribed and coded (Appendix E). Coding was based on the views from theory regarding the concepts, as addressed in Chapter 2, and was done with the purpose to categorize and order the respondents' statements. The coded transcripts will be used to present findings from the interviews regarding the key concepts of this research and the relationships between them. Relevant interview quotes will be presented to illustrate these findings. First, findings regarding the separate key concepts are presented. Then, the relationships between these concepts are analyzed and the reasons behind the observed relationships are discussed.

4.6.1. Product innovation

Looking into the first key concept, the interviews show that each of the respondents' firms has conducted activities regarding product innovation in recent years. The type of product innovations that are introduced by these firms varies. Firm B has introduced only NTTF innovations, Firm A has introduced both NTTF and NTTM innovations and Firm C is currently developing a NTTM innovation. There is quite a big variation in the percentage of employees that work in R&D (Table 4.4). Despite these

differences, all the respondents indicate that product innovation is important for the survival and success of their firm.

"You have to keep innovating and keep offering new products, or else you will not survive in this market […] There is a lot of competition from Eastern Europe and Asia. It's a bit of a rat race, but you have to stay ahead of them, which can only be done by innovating continuously." [Respondent B, food packaging]

"The product that you are developing being put on the market, that's the basis." [Respondent A, sorting machines]

"For us, it's been important to be able to continue with this [product] development." [Respondent C, laser scanners]

The respondents point out that conducting product innovation takes a lot of time and money. Furthermore, there is a chance that the time and money put into R&D does not result in a viable product. All in all, their statements show that developing and introducing new products is not an easy task.

"If you conduct innovation or start something new, you never know if it will succeed, and it costs money and time, so that's quite difficult." [Respondent B, food packaging]

"From the fundamental design, you try and make a product. And it costs an enormous amount of time." [Respondent C, laser scanners]

"We have made several prototypes for customers, but they did not really succeed." [Respondent A, sorting machines]

4.6.2. Firm independence

As stated in Chapter 2, firms that are acquired generally lose their independence. Following an acquisition, the acquirer gains control over its target. The respondents all work at firms that were acquired in recent years. Since these firms changed from being independent to being non-independent, it is possible to make comparisons between these two statuses in terms of product innovation. The interview statements show indeed that the firms could decide upon R&D matters autonomously prior to being acquired, but that they no longer have such independence since the acquisition.

"Of course, we can no longer make decisions as autonomously as before. We have to deliberate more with other people now." [Respondent C]

"The managing director of [acquirer] has to approve such investments." [Respondent B]

"We are no longer our own boss. So, we could be overruled at some point." [Respondent C]

Even though the respondents all indicate that that their firm is no longer (fully) autonomous, this does not necessarily mean that they experience significant interference from the acquirer with the innovation activities of their firm. This shows that even though acquired firms no longer have full independence, it is possible that (part of) the decisions regarding innovation are still made by the acquired firm itself.

"If they are sums [of money] that we can handle ourselves, we are allowed to make that decision on our own […] So we are relatively autonomous." [Respondent B]

"We are still fairly autonomous." [Respondent C]

"There is more deliberation, but other than that not much has changed." [Respondent C]

4.6.3. Relationship firm independence – product innovation

Now that the key concepts have been explored separately, it is time to analyze how these concepts are related to each other in the qualitative data. Using the interview codes, the respondents' statements are compared and combined to make conclusions on the relationship between the key concepts. First, the impact of losing independence on product innovation is addressed. Next, the underlying reasons for the observed effects will be discussed.

4.6.3.1. Impact of losing independence on product innovation

The first thing to look into is the impact of the loss of autonomy (as a consequence of being acquired) on the innovation activities of the respondents' firm establishments. As stated before, all firms in the qualitative analysis have conducted product innovation in recent years. The question arises whether, and if so, how their innovation activities have changed as a result of the acquisition.

Each firm establishment has conducted product innovation since their loss of autonomy. Firm A has introduced one NTTF innovation and one NTTM innovation since being acquired, as well as some improvements on existing products. Prior to the acquisition, firm A had introduced one NTTF innovation. However, since the acquisition, this firm only focuses on the sale and development of sorting machines and no longer on related products. This means that the diversity of its innovation activities has decreased. This decision was made by firm A's acquirer. Firm B has introduced three NTTF innovations since being acquired. During the last few years before the acquisition, they did not develop any new products. Firm C is still working on their NTTM innovation, just like before the acquisition. This development has significantly increased in scale since the acquisition. However, it is likely that their final product will ultimately be put on the market by their acquirer. So, even though Firm C is developing an innovation, the actual introduction of that innovation will probably be done by its parent. This means that even though the firm can continue its innovation activities, it will probably not result in the corresponding innovation outcome (i.e. putting the innovation on the market). The aforementioned decisions by the acquirer could negatively affect innovation in the future.

"That new development of weighing [products] inside the sorting machine, that's completely new. We have applied for a patent on that." [Respondent A]

"We have made the decision that we really focus on making sorting machines. Perhaps different types, but not so much on peripheral equipment/devices. That is now done by the parent company." [Respondent A]

"Especially since the acquisition, […] there are three innovations that we have introduced in the last fifteen months." [Respondent B]

"We are scaling up, that's the biggest change." [Respondent C]

"They will probably put it on the market as the parent company. And we will keep doing product development, at least part of it." [Respondent C]

So, it appears all firm establishments have either continued or increased their innovative efforts since being acquired. This is also reflected by the personnel in R&D before and after the acquisition (Table 4.4). As such, no longer being independent does not seem to have any negative consequences for these firms' product innovation activities, at least not yet. Respondents even mention some positive effects, as a result of becoming part of a group. However, losing autonomy can also lead to the acquirer limiting the acquired firm's innovation scope and/or taking over market introduction, which could have negative consequences for the acquired firms' future innovation.

4.6.3.2. Reasons behind impact of losing independence on product innovation

The next step is to take a closer look at the reasons why the innovation activities of the firm establishments have changed or not. This is what gives the addition of qualitative data to this research added value over only conducting a quantitative analysis: besides showing what impact one concept has on another, it is possible to discover in more detail why certain effects are being observed. Several reasons for the observed effects can be derived from the interviews. Being acquired leads to losing independence as well as becoming part of a group. Both aspects will be addressed below.

One of the reasons for the observed impact of the loss of independence on innovation in the respondents' firms is related to their level of retained autonomy regarding R&D matters. As stated before, there is a loss of independence in these firms as a consequence of being acquired. The acquirer now has the power to control the acquired firm. However, the acquirers appear to let the acquired firms continue with their ongoing R&D projects in a quite autonomous and non-controlling fashion. For example, the respondent of Firm C states that the acquirer wants to retain some of the firm's start-up mentality. So, even though the acquirer has the ability to intervene in the R&D activities of the acquired firm, apparently it refrains from doing so. However, this will probably change when the acquired firm's R&D efforts are not giving the desired results or when there are other issues.

"If you look at the freedom I have as head of R&D to see opportunities and take advantage of those opportunities, that hasn't changed at all. So that's really pleasant." [Respondent A]

"We are quite an autonomous firm […], also when it comes to innovation and product development. Those three innovations I just mentioned, that's all decided by us. Sometimes we get help, because [acquirer] has certain knowledge, but we basically have ultimate responsibility." [Respondent B]

"Not much has changed I think. The direction is still the same, the way of working is still the same. And they even want to maintain the start-up mentality, because they see that it enables them to be responsive." [Respondent C]

"It's mostly working together […] So in that way, they have influence, but not really in a hierarchical manner." [Respondent C]

The second reason for the observed consequences of the loss of independence on product innovation appears to be the increased access to resources following the acquisition, as a result of becoming part of a group. These resources can be used by the acquired firms to improve their R&D efforts. All respondents indicate that their firm has benefited from their acquirer's financial resources in terms of innovation. Apparently, acquirers are willing to invest in their target's R&D following the acquisition, so that they can continue their (ongoing) innovation activities. In addition to the financial resources, Firm A can make use of the acquirer's production facility, whereas Firm B can use the R&D laboratory of their parent. These resources also contribute to the firms' innovation efforts.

"Advantages in a way that it entails an increase in revenue and a solid base for the continuity of [Firm A], and also budget for R&D." [Respondent A]

"Things were not going well with [Firm B] and if you conduct innovation, it always costs money and does not always work out, […] so there was just not enough money for that." [Respondent B]

"It requires such major investments, we could have never afforded that on our own. So, it is crucial that a big firm like [acquirer] takes care of that." [Respondent C]

"Now, we have all the resources […]. Suddenly it has become unlimited, anything is possible. That's the biggest difference. Hiring people, buying equipment, no problem whatsoever." [Respondent C]

Another reason for the continued innovation appears to be the transfer of knowledge from the parent firm to the acquired firm. This is also due to becoming member of a group. Acquirers have (bigger) R&D departments with valuable knowledge and experience. This knowledge can be very useful to the acquired firm. The acquirers are willing to share their knowledge, so that the acquired firms can use it to their advantage in their own R&D activities. Two out of three firms indicate that the acquirer's knowledge improves their R&D performance. Knowledge appears to flow from the acquirer to the acquired firm a lot more than vice versa. As such, the acquired firms seem to profit more from knowledge transfer than the acquirers.

"For [Firm B] it means a lot of extra knowledge. [Acquirer] is quite big, there is a lot of knowledge there on different subjects." [Respondent B]

"Now we have an R&D department of five people within [acquirer]'s group." [Respondent B]

"They put in their expertise, so that it can be taken into production on a large scale." [Respondent C]

"They teach us processes and methods and the way of working in the automotive industry." [Respondent C]

4.6.4. Additional remarks

Besides the results from the qualitative analysis so far, there are some other interesting findings as well, which are related to the subject of this research.

Even though the firms can profit from the acquirer's resources and knowledge for introducing innovations, their NTTF innovations are not the result of simply imitating their parent's product innovations. So, the NTTF innovations do not come directly from other firms in their group. Rather, they appear to be the result of their own innovation efforts.

One of the main advantages for the acquired firms in terms of performance appears to be the increased (potential) customer base. Their acquirers offer the products to their customers and/or try to integrate the products into their own products. This leads to increased sales for the acquired firms' products.

According to the respondents, the effects of the loss of independence on the acquired firms will become clearer in the long term. Innovation can take a lot of time and it also takes time to integrate the firms and adapt to the new situation. Furthermore, the outcomes might be different when the acquired firm's R&D is not performing well. The acquirer might then decide to take control over the acquired firm's innovation activities, resulting in a (bigger) loss of autonomy. This might lead to different innovation performance over time.

4.6.5. Conclusion

In conclusion, the loss of independence does not appear to have a negative impact on the product innovation in the firms in the qualitative analysis. This means that firm independence is not positively related to product innovation. Therefore, the qualitative data do not provide support for the hypotheses regarding the impact of autonomy on product innovation.[14] This is in line with the quantitative findings. Being acquired appears to have a positive effect on product innovation, due to increased access to knowledge and resources. This means that there is some support for the hypothesis regarding the impact of group membership on innovation, whilst the quantitative results led to the rejection of these hypotheses.[15] It is however unsure if the observed advantages (in the qualitative data) will last when more time has passed since the acquisition. This could explain the different outcomes.

4.7. Combined results and conclusions

In this paragraph, the qualitative findings will be compared with the quantitative results to see how they relate to each other. The results of both types of analysis are combined to draw joint conclusions on the hypotheses.

When looking at the impact of firm independence on product innovation in general, the quantitative analysis shows that independent firm establishments are not more likely to introduce product innovations than non-independent firm establishments. There is no significant difference between these types of firms. These findings lead to the rejection of Hypotheses 1a and 1b, which predicted a positive

[14] Hypotheses 1a, 1b, 3a, 3b & 4c.
[15] Hypotheses 3c, 4a & 4b.

effect of firm independence on product innovation. The qualitative findings confirm that autonomy is not beneficial for product innovation. After all, the respondents' firms have continued (or increased) their R&D activity and performance since the acquisition. The fact that they have lost their independence does not seem to harm their product innovation (yet). In return for giving up their autonomy, the acquired firms get access to their acquirer's resources and knowledge. This helps them to improve their innovation activities. However, it is possible that these advantages are only temporary. This could explain the fact that there is no significant difference in likelihood between independent and non-independent firms in the quantitative data.

The moderating effect of firm age on the relationship between firm independence and product innovation is not significant for the comparison between HQ and subsidiary firm establishments, resulting in the rejection of Hypothesis 2b. The comparison between stand-alone firms and subsidiaries in combination with firm age is marginally significant. This effect shows that as their age decreases, the likelihood of stand-alone firms introducing product innovations decreases, compared to the likelihood of subsidiaries introducing such innovations. Since this effect is opposite from what was predicted, Hypothesis 2a is rejected. So, youthfulness makes stand-alone firms less likely to introduce product innovations compared to subsidiaries, but it has no effect on the difference in likelihood between HQ firm establishments and subsidiaries. The qualitative data appear to support these quantitative results: when looking at the amount of personnel in R&D, the younger firms seem to profit more from being acquired than the older firm.

In the remaining hypotheses, a distinction is made between new-to-the-market and new-to-the-firm innovation. When focusing on NTTM innovation, the multinomial regression analysis does not find a significant difference between HQ's and subsidiaries or between stand-alone firms and subsidiaries. This means that there is no significant impact of firm independence on this type of product innovation. Therefore, Hypotheses 3a and 3b were rejected. Furthermore, no effect of group membership on NTTM was found. After all, HQ firms do not perform better than stand-alone firms. As a result, Hypothesis 3c was confirmed. The prediction was that group membership does not have an effect on the likelihood to introduce NTTM innovations. This prediction is also confirmed by the non-significant difference between stand-alone firms and subsidiaries. Looking at the firms in the qualitative analysis that have conducted NTTM innovation, they do not appear negatively affected by their loss of autonomy. Instead, the respondents indicate that they can profit from the knowledge and resources of their parent. However, one firm did mention that the scope of their R&D has been narrowed down by their acquirer. Another firm indicated that the NTTM innovation generated by them will ultimately be put on the market by its acquirer. Thus, it appears that not being independent can have its benefits (due to group membership), but there are also potential drawbacks. All in all, the qualitative results support the rejection of the abovementioned hypotheses. After all, the firms' NTTM innovation has not declined since losing their autonomy.

The interaction term of "Firm independence" and "Firm age" shows a marginally significant difference between stand-alone firms and subsidiaries in terms of NTTM innovations. This effect shows that the likelihood of stand-alone firms to introduce NTTM innovations decreases compared to that of subsidiaries, the younger they are. However, the expectation was that the likelihood of stand-alone firms would increase compared to that of subsidiaries. Therefore, Hypothesis 5a is rejected. There is no significant difference between HQ firms and subsidiaries. Hypothesis 5b is also rejected. Thus, youthfulness makes stand-alone firms less likely to introduce NTTM innovations than subsidiaries, whilst it does not have an impact on the difference in NTTM innovation between HQ's and subsidiaries. Youthfulness does not have a positive moderating effect on the relationship between independence and NTTM product innovation. It has a negative moderating effect when stand-alone firms are compared to subsdiaries. The qualitative data are in line with the quantitative findings: the younger firms have conducted NTTM innovation since being acquired, whereas the older firm has not.

The results of the quantitative analysis on new-to-the-firm innovation show that there is no significant difference between subsidiaries and stand-alone firm establishments, which leads to the rejection of Hypothesis 4a. After all, these results show that subsidiaries are not more likely to introduce NTTF innovations because of their group membership. There is no significant difference between HQ's and stand-alone firms either: the likelihood of introducing NTTF product innovations is not higher for HQ firm establishments than for stand-alone firms. This leads to the rejection of Hypothesis 4b: HQ firms do not appear to profit from their group membership in terms of introducing NTTF innovations. The qualitative interviews do seem to point towards a positive impact of group membership on NTTF innovation in subsidiaries. The firms that introduced NTTF innovations appear to benefit from their acquirer's resources and knowledge. However, since these firms were acquired in recent years, the outcomes might be different in the long term. Certain actions from the acquirer, such as limiting the scope of R&D activities or taking over the introduction of a product innovation in the market, could counteract the initial innovation advantages of being acquired. The quantitative data imply that any positive effect of group membership is not sustainable. Another noteworthy finding is that resources and knowledge for innovation activities are transferred predominantly from the acquirer (HQ) to the acquired firm (subsidiary) and not so much the other way around. This could explain the lack of support for Hypothesis 4b in the quantitative data. This hypothesis stated that since HQ firms can profit from group membership, they are more likely to introduce NTTF innovation than stand-alone firms.

When looking at the difference in likelihood to introduce NTTF innovations between subsidiaries and HQ's – both are group firms but HQ's are independent and subsidiaries are not – the quantitative analysis shows no significant effect. This indicates that among group firms, there is no impact of autonomy on NTTF innovation. Hypothesis 4c is rejected. The qualitative analysis does not show that the non-independent firm establishments are negatively affected by the absence of autonomy in terms of

introducing NTTF innovations. As such, the qualitative data do not contradict the rejection of the aforementioned hypothesis.

The interaction of firm age with firm independence on the likelihood of NTTF innovations resulted in a significant difference between stand-alone firm establishments and subsidiaries. As firm establishments get older, the likelihood of subsidiaries introducing NTTF innovations compared to that of stand-alone firms decreases. This means that youthfulness does not make stand-alone firm establishments more likely to introduce NTTF product innovations compared to subsidiaries; in fact, it makes them less likely to do so. Since the aforementioned effect is different from what was hypothesized, Hypothesis 6a is rejected. There is no significant difference between HQ's and subsidiaries for this interaction term, which leads to the rejection of Hypothesis 6b. Youthfulness does not play a role when HQ firm establishments are compared to subsidiaries. As for the qualitative analysis, there is no data that supports these hypotheses either. Therefore, the quantitative results are decisive.

All in all, it turns out that firm independence does not have an impact on the likelihood to introduce product innovations. This is true for product innovation in general, but also for both NTTM and NTTF product innovation in specific. Group membership can have benefits for an acquired firm's product innovation, but this beneficial effect appears to be only temporary. As for the moderating effect of youthfulness, young subsidiaries appear to perform better in terms of product innovation compared to stand-alone firms. However, this effect disappears as firms get older. In the next chapter, more elaborate conclusions will be drawn from the findings in this chapter.

Chapter 5 – Conclusion and discussion

5.1. Introduction

This chapter contains a summary of the research, conclusions regarding the research questions and a discussion of the results of this research. Furthermore, theoretical and practical implications will be addressed, as well as some limitations. Finally, a reflection of the research process and the role of the researcher will be given.

5.2 Summary of research

The main objective of this research, which is discussed in the first chapter, is to discover what effect firm independence has on product innovation. The rationale behind this central question is that when a firm acquires another firm with the goal to get access to its innovation, the innovative capabilities that enabled the target firm to introduce the innovations before being acquired might be harmed afterwards, due to a loss of autonomy.

Chapter 2 presents the theoretical framework. First, the key concepts of product innovation and firm independence have been defined. Then, relevant theory and empirical evidence have been examined to form expectations on the impact of firm independence on product innovation. The sources pointed towards a negative impact of not having autonomy (as a result of being acquired) on product innovation. The findings resulted in the presumption that firm independence is beneficial for product innovation. This relationship was also predicted for NTTM product innovations in particular. For NTTF innovations however, group membership appeared to be more important than autonomy. For NTTM innovations, no positive impact of group membership was predicted. Additionally, firm youthfulness was expected to have a positive moderating effect on the relationship between firm independence and product innovation.

Chapter 3 addresses the research methodology. A mixed methods design was chosen, so that qualitative data could be used to complement and get a more profound understanding of the quantitative outcomes. For the quantitative part, logistic regression analyses were conducted on data from the 2009 EMS survey, containing data from firm establishments in the Dutch manufacturing industry. The qualitative data were gathered by conducting three interviews at Dutch manufacturing firms that were recently acquired by another firm.

In Chapter 4, the results of the analyses are presented. The quantitative analyses do not provide support for the hypotheses related to the presumption that firm independence has a positive impact on product innovation. The results are the same for the effect of autonomy on NTTM and NTTF innovation when analyzed separately. Furthermore, no significant effect of group membership on NTTF innovation was found. Therefore, the corresponding hypotheses, proposing a positive impact of group membership on

NTTF innovation were rejected. There was no impact of group membership on NTTM innovation either. Since this was as predicted, the relevant hypothesis was confirmed. As for the moderating effect of firm youthfulness, the results indicate that the likelihood of independent firms to introduce (NTTM and NTTF) product innovations does not increase compared to that of non-independent firms, when the firms are younger. This indicates that youthfulness does not have a positive moderating effect on the relationship between firm independence and product innovation. In fact, there appears to be a negative moderating impact of youthfulness when stand-alone firms are compared to subsidiaries. As a result, the corresponding hypotheses were rejected. The results from the qualitative analysis do not demonstrate a negative impact of losing autonomy on product innovation in the acquired firms, which is in accordance with the quantitative findings. The firms' innovation activities even appear to benefit from being acquired, as a result of getting access to intragroup resources and knowledge. However, since the firms in the qualitative analysis were acquired in recent years and since the quantitative data did not find an effect of group membership on innovation, it seems that the positive consequences from being acquired generally only last for a limited amount of time.

5.3. Conclusions

The central research question of this thesis focuses on the effect of firm establishment independence on the amount of product innovation in firm establishments. In order to answer this question, the impact of independence on product innovation in general was analyzed, as well as the effect of on NTTM product innovation and on NTTF product innovation separately. Furthermore, since not being independent entails group membership, the impact of group membership on NTTF product innovations was also tested. In addition, the moderating effect of youthfulness on the aforementioned relationship was checked. Below, the research questions are answered.

What is the effect of firm independence on (new-to-the-market and new-to-the-firm) product innovation in firm establishments?

The quantitative results show that HQ firm establishments and stand-alone firms do not introduce more product innovations than subsidiaries. This is true for product innovations in general, but also for NTTM product innovations in specific. There is no difference between HQ's and subsidiaries in terms of NTTF innovations either. The fact that there is no (significant) difference between independent and non-independent firm establishments in terms of product innovation indicates that independence does not have an effect on a firm's likelihood to introduce product innovations. The qualitative data demonstrate no negative consequences of losing independence on product innovation in firms that were acquired in recent years. No longer having (full) autonomy has not affected their innovation activities in a negative way. In fact, acquired firms even appear to increase their innovative activities following the acquisition. However, over time, their acquirers could make decisions regarding the R&D activities of the acquired firms that could cancel the initial increase in product innovation and could even harm innovation.

What is the effect of group membership on new-to-the-firm and new-to-the-market product innovation in firm establishments?

When looking at the effect of group membership on NTTF and NTTM product innovation, the quantitative analyses demonstrate that there is no significant difference between HQ's and stand-alone firms in terms of likelihood to introduce such innovations. Furthermore, there is no difference between subsidiaries and stand-alone firms either. This indicates that there is no effect of group membership on NTTF and NTTM product innovation. After all, group firms do not perform better than non-group firms. In the qualitative data, group membership appears to have a positive impact on the acquired firms' activities regarding innovation. This seems to be true for both NTTF innovation and NTTM innovation. The observed positive effects are caused by increased access to resources and knowledge, provided by the acquirer. However, whether this effect will last when more time has passed since being acquired is questionable. After all, the quantitative data do not support a positive impact of group membership.

Is the effect of firm independence on (new-to-the-firm and new-to-the-market) product innovation different for younger firms than for older firms?

As for the moderating effect of youthfulness on the relationship between firm independence and product innovation, the analyses show that there is no positive moderating effect of youthfulness when independent firms are compared to non-independent firms. This means that any impact of not being independent on innovation is not worse for younger firms than for older firms. Youthfulness even has a negative moderating effect when stand-alone firms are compared to subsidiaries. This could mean that young subsidiaries are better at product innovation than young stand-alone firms. However, overall there is no difference between these two types of firm establishments in terms of likelihood to introduce product innovations.

Looking at all the results jointly, firm independence does not have an impact on the amount of product innovations a firm introduces. Overall, there is no significant difference between independent and non-independent firm establishments in terms of product innovation. Firms that were recently acquired appear to perform better in terms of product innovation than before, because of group membership-related benefits. However, this effect is thought to be only temporary. Therefore, the increase in innovation activities in recently acquired firms does not change the main conclusion of this research that firm independence generally has no impact on the likelihood to introduce product innovations.

5.4. Discussion

Now that the research questions have been answered, the results of this thesis can be further interpreted by discussing them in the context of the presumptions that were made in the theoretical framework.

Based on existing theory and empirical evidence, the presumption was made that firm independence is positively related to product innovation. One of the main reasons for this presumed positive effect was that losing autonomy (as a result of being acquired) is generally harmful for innovation, due to integration-related measures by the acquirer. Such measures can lead to issues that could harm innovation. The results of this research on the impact of firm independence on product innovations are different from what was expected based on the theoretical framework. One possible explanation for the unexpected outcomes is that with being acquired, the actual amount of decision-making freedom that is lost is less than presumed in theory. Even though acquired firms no longer have full autonomy, this does not necessarily mean that the acquirer takes control over all the activities of its new subsidiary. As such, it is possible that an acquired firm remains relatively autonomous in terms of R&D. This appears to be the case for the firms in the qualitative analysis. Even though some decisions are now made by their acquirers, they still have quite a lot of freedom to decide upon (most of) their own innovation-related matters. As such, the creative process of conducting R&D is not affected. So, subsidiaries can be relatively autonomous and as a result might not experience (most of) the negative effects of losing autonomy on innovation as mentioned in the theoretical framework. This could explain why in this research non-independent firms are not found to perform worse on innovation than independent firms.

Another possibility for not finding an effect of independence on product innovation is that being controlled by another firm might not be as harmful for innovation as presumed in existing theory. Autonomy gives a firm the freedom to pursue ambitious R&D projects, which could lead to successful innovation. However, R&D projects generally cost a lot of time and money, and often fail to deliver a viable product. Some sort of control and/or advice from another firm might help to prevent (some) R&D failures. Being told how to conduct R&D activities by another firm might sound like a constraint, but one has to take into account the possibility that the parent firm's decisions could improve innovation performance in the subsidiary. The acquirer might have superior experience, skills and knowledge in the field of innovation, which it can use to the acquired firm's advantage. So, even though there are scenarios in which losing autonomy (and integration) can be harmful for the acquired firm's innovation, in reality these scenarios might often not turn out as predicted in the theoretical framework.

As stated before, not being independent encompasses group membership. As such, non-independent firms have the possibility to profit from intragroup knowledge and resources. HQ firm establishments can benefit from group membership in a similar way. Existing theory and empirical evidence implied that group membership was beneficial for NTTF innovations, but not for NTTM innovations. The argumentation was that a NTTF innovation can be the result of transferring an existing innovation from one firm to another, whereas a NTTM innovation (by definition) has to be generated by the firm itself. The results of this thesis indicate that group membership is generally not beneficial for NTTM and NTTF innovation, but that recently acquired firms do seem to profit innovation-wise from having become part of a group. The reason that the effect of group membership is only temporary could be that

after an acquisition, the acquirer supports the acquired firm to finish its ongoing R&D projects. However, the acquirer might not want to invest in starting new R&D projects in the acquired firm. It may be the case that acquirers eventually want to locate (most of) the R&D activities for their group in one or more specific locations, as part of the integration process and with the goal to increase efficiency, reach synergies and achieve economies of scale.

As for HQ firm establishments, the fact that they do not appear to benefit from their group membership in terms of innovation could be because they profit from their subsidiaries in the form of financial performance instead of innovative performance. The introduction of innovations might take place (mainly) at the subsidiary level.

In the theoretical framework, it was predicted that not being autonomous is worse for younger firms than for older firms, because losing autonomy was presumed to negatively affect young firms more than older firms. The results show that there is no moderating effect of youthfulness when HQ firms are compared to subsidiaries, whereas the moderating effect of youthfulness on product innovation when stand-alone firms are compared to subsidiaries is negative. As such, the impact of youthfulness on the relationship between firm independence and product innovation is different than expected from theory. One explanation for the increase of likelihood of subsidiaries to introduce product innovations compared to that of stand-alone firms as the firms are younger could be that young innovative firms are desirable acquisition targets. This could lead to an increase in young, innovative subsidiaries. Another explanation could be that younger subsidiaries experience more benefit from group membership than older ones. Finally, stand-alone firms might only be able to survive for a longer period of time if they are successful innovators, whereas (some) subsidiaries might be able to survive due to support from their group instead of their own success.

5.5. Theoretical and practical implications

Based on the outcomes of this research, implications and recommendations can be presented for both future research and practice.

The findings in this thesis contribute to the existing body of knowledge on the relationship between firm independence and product innovation in the following ways. Firstly, by recognizing the conjunction of not having autonomy with group membership, it takes into account any countereffect of resource and knowledge transfer on not having decision-making freedom. The distinction between HQ's, subsidiaries and stand-alone firms gives a better understanding of both autonomy and group membership, combined in one study. Secondly, by using a mixed methods approach, this research provides a deeper understanding of the role of autonomy in R&D (innovation) activities. It gives an insight in the interplay between acquirers and acquired firms following M&A. The use of two types of data made it possible to

not only look at the impact of firm independence on product innovation, but also at the specific impact of losing independence on innovation.

In order to better understand a possible impact of firm independence on product innovation, additional research on this subject could be useful. One opportunity for future research is to further clarify the role of decision-making freedom in R&D activities, by measuring various levels of autonomy firms might have. Furthermore, further research could be done on the effects of losing autonomy (as a result of being acquired) over a longer period of time. One might consider analyzing firms in a longitudinal study. This could give more insight in the long-term strategy of acquiring firms regarding innovation-driven M&A. Finally, considering the impact of group membership on innovation, future research could focus on the various elements of group membership that (could) influence innovation, making a distinction between financial resources, knowledge, and other types of benefits. This could improve the understanding of the role of group membership for different types of firm establishments.

Based on the results, some practical implications and recommendations can be made. Since not being independent does not appear to be harmful for a firm's innovation and since being acquired can have its (short-term) benefits, firms should realize that giving up their autonomy is not necessarily a bad thing to do. After all, it could provide them with an opportunity to boost their innovation, by using resources and knowledge from their acquirer. On the other hand, though, this research has also shown that group membership does not guarantee superior innovation performance. On average, group firms are not more successful at innovation than non-group firms. So, even though becoming part of a group could help a firm's innovation, it is not a requirement for becoming a successful innovator. Firms should carefully assess the pros and cons of getting acquired prior to putting the firm up for sale. In doing so, they should look at both the short-term and long-term effects of a possible acquisition. When a firm is acquired, some level of autonomy should remain for the acquired firm, at least in terms of conducting R&D. This enables for ongoing innovation in the acquired firm, of which both parties could benefit. Maintaining (some of) the so-called start-up mentality appears to be a good strategy when aiming for continued innovation. Acquirers should use this knowledge to their advantage. After all, in the end, continued innovation in subsidiaries is beneficial for both the parent firm and its subsidiaries.

5.6. Limitations of research

For this research, there are some limitations that should be considered when interpreting its results. These are addressed below.

Even though the EMS survey is of professional quality and quite extensive, it was not designed specifically for this research. Instead, a selection of relevant indicators from this existing survey was made for use in this research. Some of these indicators are binary, whereas an indicator with more than two categories might have provided additional insight. This makes the measurement of some concepts

less accurate than ideal. However, the interviews do make it possible to explore the key concepts in more detail and therefore compensate for this limitation to a certain extent.

As for the qualitative data, they only give insight in the impact of losing autonomy on product innovation in the first few years. Data from firms that were acquired many years ago would have made it easier to make conclusions about the long-term effects of losing independence on innovation.

The respondents of the survey and interviews are employees of firm establishments in the Dutch manufacturing industry. As a result, the possibility to generalize the research findings to other countries and/or other industries is limited. The small number of interviews and the low response rate in the EMS survey further limits the generalizability of the outcomes of this thesis.

5.7. Reflection

In Chapter 3, statements were made regarding research ethics in light of this thesis. Some final remarks can also be made about the process of this research and the role of myself as a researcher.

Initially, my proposal of this research only contained quantitative data. However, the advice was given to also include qualitative data. Finding suitable firms for the interviews turned out to be quite difficult, because of the various selection criteria. However, once the respondents had been found, the process of conducting the interviews went smooth. Analyzing both types of data and combining them was a challenge, but overall there were no (major) issues. In my opinion, the addition of interviews as an extra source of information has greatly improved the quality of the research outcomes. The outcomes of the research are surprising to me, because they are quite different from what was expected based on the theoretical framework. However, in my opinion, the results are useful and informative nonetheless. All in all, I am convinced that I conducted this research in an objective and ethical manner and that my personal opinions did not influence the quality and process of this thesis in a negative way.

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Appendix A – Interview Script

Respondent:

Datum, tijd & locatie:

Introductie

Mijn naam is Bastiaan Henderik. Ik ben masterstudent Bedrijfskunde aan de Radboud Universiteit Nijmegen, met Strategic Management als afstudeerrichting. In het kader van mijn master schrijf ik een scriptie over productinnovaties binnen Nederlandse bedrijven in de maakindustrie. Dit interview zal zich met name richten op (mogelijke) veranderingen die hebben plaatsgevonden als gevolg van de overname van uw bedrijf ten aanzien van de ontwikkeling en introductie van productinnovaties.

Het interview zal ongeveer een half uur in beslag nemen. Ik zou ons gesprek graag willen opnemen indien u hier geen bezwaar tegen heeft. Deze opname zal ik gebruiken voor de uitwerking van het interview. De uitwerking zal ik ter goedkeuring naar u opsturen. Het interview zal worden geanonimiseerd, zodat deze gegevens niet zijn te herleiden naar u of uw organisatie. Mijn scriptie zal worden gelezen en beoordeeld door mijn begeleiders. Ik zal u een kopie van mijn scriptie toesturen indien u daar prijs op stelt.

Ik heb uw bedrijf benaderd voor een interview omdat deze actief is in de Nederlandse maakindustrie en in de afgelopen jaren is overgenomen door een ander bedrijf. U bent gekozen als geïnterviewde vanwege uw kennis en ervaring op het gebied van de aangelegenheden binnen uw organisatie waarin ik geïnteresseerd ben.

Algemene informatie

1. Hoe lang bent u al werkzaam bij [bedrijf]?
2. Wat is uw huidige functie binnen [bedrijf]?
3. Kunt u (kort) iets vertellen over de activiteiten en producten van [bedrijf]?
4. Hoeveel werknemers heeft [bedrijf]?
5. Hoe lang bestaat [bedrijf] al?
6. Wanneer is [bedrijf] overgenomen en door welke onderneming?
7. Hoeveel werknemers telt deze onderneming?

De rest van het interview gaat over [bedrijf] en niet over de onderneming waardoor uw bedrijf is overgenomen. Onder productinnovatie versta ik zowel nieuwe producten als bestaande producten die in belangrijke mate zijn vernieuwd.

Situatie na overname

Indien overname meer dan drie jaar geleden is:

8. Heeft uw bedrijf in de afgelopen drie jaar nieuwe producten of in belangrijke mate vernieuwde producten geïntroduceerd?
    a. Zo ja, welke?
    b. Zaten daar ook producten bij die nieuw waren voor de markt?
9. Heeft uw bedrijf medewerkers in dienst die specifiek bezig zijn met de ontwikkeling van nieuwe of sterk vernieuwde producten?
    c. Zo ja, om hoeveel FTE gaat het?

Indien overname minder dan drie jaar geleden is:

10. Heeft uw bedrijf sindse de overname nieuwe producten of in belangrijke mate vernieuwde producten geïntroduceerd?
    a. Zo ja, welke?
    b. Zaten daar ook producten bij die nieuw waren voor de markt?
11. Heeft uw bedrijf medewerkers in dienst die specifiek bezig zijn met de ontwikkeling van nieuwe of sterk vernieuwde producten?
    a. Zo ja, om hoeveel FTE gaat het?

Situatie op moment van overname

12. Hoeveel werknemers telde uw bedrijf op het moment van de overname?
13. Had uw bedrijf op het moment van overname medewerkers in dienst die specifiek bezig waren met de ontwikkeling van nieuwe of sterk vernieuwde producten?
    a. Zo ja, om hoeveel FTE ging het?

Situatie voorafgaand aan overname (innovatie; zelfstandigheid)

14. Welke producten bood [bedrijf] aan voorafgaand aan de overname?
    a. Waren die producten door [bedrijf] zelf ontwikkeld?
    b. Zaten er producten bij die [bedrijf] als eerste in de markt aanbood?
15. Wie bepaalde voorafgaand aan de overname het innovatiebeleid binnen [bedrijf]?

Gevolgen van overname voor innovatie (zelfstandigheid ; kennisoverdracht)

16. Wat was (volgens u) de voornaamste reden voor de overname van [bedrijf]?
17. Welke veranderingen hebben er sinds de overname plaatsgevonden op het gebied van productinnovatie?
18. Welke veranderingen hebben er plaatsgevonden ten aanzien van de manier waarop het innovatiebeleid in [bedrijf] wordt bepaald en door wie dit wordt gedaan?
19. In hoeverre heeft het moederbedrijf invloed op de innovatie-aangelegenheden van [bedrijf]?
20. Welke voordelen en/of nadelen heeft de overname voor [bedrijf] gebracht op het gebied van productinnovatie?
21. In hoeverre heeft [bedrijf] gebruik kunnen maken van kennis of andere middelen van het moederbedrijf bij de ontwikkeling en/of introductie van nieuwe of vernieuwende producten?
22. Welke invloed denkt u dat de overname zal hebben op de productinnovatie binnen [bedrijf] op de lange termijn?

Afronding

Hiermee zijn we aan het einde gekomen van dit interview. Wilt u nog iets zeggen over de onderwerpen die we zojuist besproken hebben? Heeft u nog vragen? Zoals gezegd zal dit interview worden geanonimiseerd. De uitwerking van het interview zal ik naar u opsturen ter controle. Tevens zal ik de eindversie van mijn scriptie naar u opsturen als u daar interesse in heeft. Mag ik hiervoor uw gegevens noteren? Hartelijk dank voor uw deelname aan dit interview.

Duur interview:

Contactgegevens respondent:

Appendix B – Operationalization table

The variables in the quantitative analysis are operationalized as follows:

Variable type	Model	Variable name	Indicator(s)	Min. value	Max. value	Measurement level
Independent	A & B	Firm independence	Type of firm establishment	0	1	Nominal
Moderator	A & B	Firm age	Year of foundation	1	173	Ratio
Dependent	A	Product innovation	Adoption of product innovations (Y/N)	0	1	Nominal (Binary)
Dependent	B	Product innovation (newness)	Adoption of product innovations (Y/N)	0	1	Nominal
			Adoption of new-to-the-market product innovations (Y/N)	0	1	Nominal
Control	A & B	Firm size	Number of employees	10		Ratio
Control	A & B	Internal R&D size	Percentage of employees in R&D	0	100	Ratio
Control	A & B	Industry	Type of industry	0	1	Nominal
Control	A & B	Multinationality	Type of firm establishment	0	1	Nominal (Binary)
Control	A & B	Process innovation	Application of process innovations	0	13	Ratio
Control	A & B	Firm age	Year of foundation	1	173	Ratio

Appendix C – EMS survey 2009

Radboud Universiteit Nijmegen
Institute for Management Research

Modernisering van de productie

Enquête 2009

Deze vragenlijst heeft als doel inzicht te krijgen in de inspanningen van industriële bedrijven in Nederland om hun productie en bedrijfsprocessen te moderniseren. De enquête wordt ook in elf andere Europese landen gehouden. Internationale vergelijking wordt daardoor mogelijk. Om ook uw bedrijf zelf daarvan te laten profiteren is er voor u de mogelijkheid geschapen zelf een on-line benchmark uit te voeren zowel met bedrijven in Nederland als in het buitenland. Te zijner tijd ontvangt u daarover nadere informatie. In de vragenlijst worden gegevens verzameld over het gebruik van nieuwe technologieën, organisatieconcepten en over indicatoren zoals productiviteit, flexibiliteit, kwaliteit en productiekosten.

Het onderzoek richt zich op productiebedrijven met een omvang van ten minste 10 werknemers. Bij ondernemingen met meerdere vestigingen, hebben de vragen betrekking op de aangeschreven vestiging en niet op de totale onderneming.

Voor het onderzoek is beantwoording van alle vragen van belang. Ook als niet alle genoemde technologieën of organisatieconcepten van toepassing zijn op uw bedrijfsvestiging, verzoeken wij u vriendelijk de vragenlijst toch volledig in te vullen.

Hartelijk dank voor uw medewerking

0.1 Is uw bedrijfsvestiging (kruis slechts één optie aan):

- ☐ Het hoofdkantoor van een onderneming/groep met ook buitenlandse vestigingen
- ☐ Het hoofdkantoor van een onderneming/groep met alleen binnenlandse vestigingen
- ☐ Een dochter/divisie van een onderneming/groep met buitenlandse vestigingen
- ☐ Een dochter/divisie van een onderneming/groep met alleen binnenlandse vestigingen
- ☐ Een zelfstandige onderneming

0.2 Wie is in meerderheid of exclusief eigenaar van het bedrijf waartoe uw bedrijfsvestiging behoort?

☐ Private eigenaar/ familie ☐ Financiële investeerder (bijv durfkapitaal) ☐ Ander bedrijf (bijv. niet-financiële investeerder) ☐ stichting ☐ overige eigenaren ☐ Geen meerderheidseigenaar

→ Is de familie actief in het management? ☐ Nee ☐ Ja

Hoe belangrijk zijn op dit moment de volgende maatregelen voor de modernisering van uw productie?
(Ken daarbij een rangvolgorde toe van 1 tot 3, 1 = het belangrijkst. Elk cijfer slechts een keer gebruiken)

Investeringen in machines/ uitrusting/ICT	Organisatorische maatregelen/ veranderingen	Personeelsontwikkeling (training, scholing etc.)
○	○	○

Welke van de volgende technologieën worden momenteel in uw bedrijfsvestiging toegepast?

Technologieën toegepast in uw bedrijfsvestiging	Nee	Ja	Voor het eerst gebruikt (jaar)[1]	Omvang toegepaste potentieel[2] (g=gering/m=midden/h=hoog)	Belangrijkste doel van de toepassing (slechts één optie aankruisen): Verbetering kwaliteit/ proces	Verbetering kosten/ productiviteit	Vergroting flexibiliteit	Product-innovatie
Automatiseringen integratie								
— Integratie van digitaal productontwerp /-engineering met machineprogrammering	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Industriële robots (voor hanteren van gereedschap en werkstukken) in fabricage en assemblage	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— In het proces geïntegreerde kwaliteitscontrolesystemen (bijv. met laser, ultrageluid, beeldverwerking)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Gebruik van Radio Frequency Identification (RFID) in interne of externe logistiek	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Gebruik van gesautomatiseerde warehouse managementsystemen (WMS) voor interne logistiek en orderverzamelen	☐	☐ →	19/20	g m h	☐	☐	☐	☐
Bewerkings- en productietechnologieën								
— Laser als werktuig (bijv. Snijden, lassen, vormen, micro-structuren)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Droge bewerkingen/bewerkingen met minimale hoeveelheden smeermiddel)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Rapid prototyping of rapid tooling (bijv. laser sinteren, stereo lithografie, 3D-printen)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Toepassing van bio- en gentechnologie in fabricageprocessen (bijv. Catalysatoren, bioreactoren)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Verwerking van nieuwe materialen (bijv. composiete, duurzame grondstoffen)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
Digitale fabriek / IT netwerken								
— Digitale uitwisseling van productieplannings-gegevens met supply chain managementsystemen van toeleveranciers/klanten	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Manufacturing Execution Systems (MES) (d.w.z. integratie van productieplanning/ERP met registratie van productiegegevens, CAM)	☐	☐ →	19/20	g m h	☐	☐	☐	☐
— Virtual Reality en/of simulatie in productontwikkeling en/of fabricage	☐	☐ →	19/20	g m h	☐	☐	☐	☐

Toelichting:
1 Het jaar waarin deze technologie voor het eerst werd toegepast in uw bedrijfsvestiging (maak een schatting indien u onzeker bent over het exacte jaar).
2 Daadwerkelijke toepassing ten opzichte van maximaal zinnvolle toepassingsmogelijkheden in uw bedrijfsvestiging: omvang van het

Worden andere innovatieve technologieën gebruikt in uw bedrijfsvestiging?

Nee ☐ Ja ☐ Welke?

Voor het eerst toegepast (jaar) 19/20

Voor het eerst toegepast (jaar) 19/20

3.1 Welke van de volgende organisatieconcepten en werkwijzen worden momenteel in uw bedrijfsvestiging toegepast?

Organisatieconcepten toegepast in uw bedrijfsvestiging	Nee	Ja	Voor het eerst gebruikt (jaar)[1]	Omvang toegepaste potentieel[2] (g=gering/m=midden/h=hoog)	Belangrijkste doel van de toepassing (slechts één optie aankruisen): Verbetering kwaliteit/ precisie	Verbetering productiviteit	Verbetering flexibiliteit	Product-innovatie
Arbeidsorganisatie								
– Autonome taakgroepen in de productie	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Taakverrijking (integratie van planning, uitvoering of controle)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Tijdelijke cross-functionele teams	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
Organisatie van de productie								
– Klant- en/of productgeoriënteerde inrichting van productie-eenheden (i.t.t. Functionele indeling)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Afschaffen van tussenvoorraden in het productieproces (bijv. kanban)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Total Cost of Ownership (TCO: planning van investeringen en activiteiten op basis van de totale, de gehele levenscyclus dekkende kosten)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
Standaardisatie, kennismanagement								
– Kwaliteitskringen	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Kennismatrix (incl. documentatie van al dan niet benutte kwalificaties van medewerkers)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Kwaliteitsmanagement op basis van ISO 9000-serie	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
Arbeidstijden en beloningssystemen								
– Collectieve regelingen voor flexibel werken (arbeidstijdrekeningen)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Beloningssystemen met toeslagen voor teamprestaties	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Financiële participatie die open staat voor alle werknemersgroepen (bijv. winstdelingsregelingen, aandelen(opties)plannen, enz.)	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
Personeelsbeleid								
– Regelmatige ontwikkelingsgesprekken met medewerkers	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Trainingsprogramma's voor medewerkers als speerpunt binnen het personeelsbeleid	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐
– Mogelijkheid voor medewerkers om thuis te werken	☐	☐ →	19/20 ☐☐	g m h	☐	☐	☐	☐

Toelichting:
[1] Het jaar waarin dit organisatieconcept voor het eerst werd toegepast in ons bedrijf (maak een schatting indien u onzeker bent over het exacte jaar).
[2] Daadwerkelijke toepassing ten opzichte van maximaal zinnvolle toepassingsmogelijkheden in ons bedrijf: omvang van het toegepaste

3.2 Worden andere innovatieve organisatieconcepten gebruikt in uw bedrijfsvestiging?

Nee ☐ Ja ☐ → Welke?

Voor het eerst toegepast (jaar) 19/20 ☐☐

Voor het eerst toegepast (jaar) 19/20 ☐☐

4.1 Welke van de volgende productgerelateerde diensten biedt u uw klanten aan?

	nee	ja, sinds 3 jaar of langer	ja, sinds minder dan 3 jaar		nee	ja, sinds 3 jaar of langer	ja, sinds minder dan 3 jaar
Ontwerp, advies, projektplanning (incl. R&D voor klanten)	☐	☐	☐	Montage en opstart	☐	☐	☐
Technische documentatie (instellen, bediening, onderhoud)	☐	☐	☐	Opleiding en scholing	☐	☐	☐
Ontwikkeling van software	☐	☐	☐	Onderhoud en reparatie (incl. teleservice)	☐	☐	☐
Leasing, verhuur, financiering	☐	☐	☐	Bediening van het product/ de installatie voor en/of bij de klant	☐	☐	☐

4.2 Indien u productgerelateerde diensten aanbiedt, hoe hoog schat u het aandeel daarvan in de totale omzet

Welk percentage van de totale omzet hadden de diensten die u de klant direct in rekening heeft gebracht in 2008? ca. ☐☐ %

Welk percentage van de totale omzet hadden de diensten die u de klant indirect in rekening heeft gebracht in 2008? ca. ☐☐

4.3 Biedt u sinds 2006 nieuwe productgerelateerde diensten aan die geheel nieuw voor uw bedrijfsvestiging zijn of in belangrijke mate technologisch zijn vernieuwd

☐ nee ☐ ja → Hoe groot was het aandeel van deze nieuwe productgerelateerde diensten in de omzet van het jaar 2008? ca. ☐☐ %

4.4 Indien u sinds 2006 nieuwe productgerelateerde diensten aanbiedt, wie heeft deze diensten ontwikkeld en ontworpen?

	leidend	relevante rol	in bepekte mate betrokken	niet betrokken	dergelijke afdeling niet aanwezig
Verkoop en marketing	☐	☐	☐	☐	☐
Klantenservice	☐	☐	☐	☐	☐
Onderzoek en productontwikkeling	☐	☐	☐	☐	☐
Management	☐	☐	☐	☐	
Anders, nl.:	☐	☐	☐	☐	

5.1 Zijn gedurende de laatste drie jaar nieuwe producten of in belangrijke mate technologisch vernieuwde producten (kleine verbeteringen buiten beschouwing laten) in productie genomen in uw bedrijfsvestiging (bijv. toepassing van nieuwe materialen, veranderingen in productfunctlies enz.)?

☐ nee ☐ ja → Welk percentage van de omzet hadden deze producten in 2008? ca. ☐☐☐ %

→ Hoe lang duurde gemiddeld genomen de ontwikkeling van een dergelijk product (zgn. time to market)? ca. ☐☐☐ maanden

5.2 Waren daar ook producten bij die niet alleen nieuw waren voor uw bedrijf, maar ook voor de markt?

☐ nee ☐ ja → Welk aandeel hadden deze producten in de totale omzet in 2008? ca. ☐☐☐ %

5.3 Heeft uw bedrijfsvestiging producten in het programma die u al langer dan 10 jaar aanbiedt?

☐ nee ☐ ja → Welk aandeel hadden deze producten in uw totale omzet van 2008? ca. ☐☐☐ %

6 In de voorgaande vraag heeft u informatie gegeven over uw activiteiten op het gebied van technologie, organisatie, product-gerelateerde diensten en productvernieuwing. Hoe belangrijk zijn deze vernieuwingsactiviteiten in uw bedrijfsvestiging?
(Geef met een score van 1 tot 4 de volgde van belangrijkheid aan:, 1 = het belangrijkst, gebruik elke score slechts één keer)

Aanvulling van uw producten met diensten	Organisatievernieuwing	Technische innovatie in het productieproces	Ontwikkeling van nieuwe producten
○	○	○	○

Heeft uw bedrijfsvestiging in de afgelopen twee jaar delen van de productie of delen van onderzoek en ontwikkeling overgeheveld naar andere bedrijven (uitbesteding) of eigen vestigingen in het buitenland (verplaatsing)?

Overheveling:

nee	Ja: (meerdere opties mogelijk) Naar andere bedrijven in Nederland	Naar andere bedrijven in het buitenland	naar eigen vestigingen in het buitenland	Naar welk land (landen)	Redenen: (meerdere opties mogelijk) Arbeidskosten	Ontsluiten nieuwe markten	Nabijheid van belangrijke klanten	Toegang tot innovatieve kennisclusters	Belastingen, heffingen, subsidies	Gebrek aan gekwalificeerd personeel	transportkosten/ logistieke kosten	Nabijheid tot O&O of productie die reeds is overgeheveld	Naar buitenland verplaatste arbeidsplaatsen (sinds 2007) Totaal (aantal)
Overheveling van **productie-activiteiten** sinds 2007													
☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐	
Overheveling van **onderzoeks- en ontwikkelingsactiviteiten** sinds 2007													
☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐	

Terugplaatsing (repatriering) vanuit het buitenland

nee	ja	Vanuit uw vestigingen in het buitenland	Vanuit andere bedrijven in het buitenland	uit welk land (landen)	Redenen: (meerdere opties mogelijk) Kwaliteit	Flexibiliteit, leveringszekerheid	Beschikbaarheid gekwalificeerd personeel	Arbeidskosten	Transportkosten/ logistieke kosten	Coordinatie/ communicatiekosten	Infrastructuur	Kennisoverdracht-koppeling/ plaatselijk	Teruggeplaatste arbeidsplaatsen Totaal (aantal)
Terugplaatsing van delen van de **productie**													
☐	☐→	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐	
Terugplaatsing **onderzoeks- en ontwikkelingsactiviteiten**													
☐	☐→	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐	

Heeft uw bedrijfsvestiging reeds in de periode 1999 tot en met 2006 delen van de productie of onderzoek en ontwikkeling naar het buitenland overgeheveld (offshoring) of teruggeplaatst (backshoring)?
(Ga bij uw antwoorden uit van offshoringactiviteiten naar eigen buitenlandse vestigingen en naar andere buitenlandse bedrijven)

	nee	ja
Offshoring van delen van de productie	☐	☐
Offshoring van delen van onderzoek en ontwikkeling	☐	☐

	nee	ja
Backshoring van delen van de productie	☐	☐
Backshoring van delen van onderzoek en ontwikkeling	☐	☐

Wat is het opleidingsniveau van het personeel van uw bedrijfsvestiging?

Hoger onderwijs (WO+HBO)	ca.		%
MBO technische opleiding	ca.		%
MBO administratieve en commerciële opleiding	ca.		%
LBO of ongeschoold	ca.		%
Personeel in opleiding (leerlingen)	ca.		%

=100%

Hoe is het personeel in uw bedrijfsvestiging verdeeld over de volgende werkterreinen:

Onderzoek en ontwikkeling	ca.		%
Ideevorming, ontwerp en vormgeving	ca.		%
Fabricage en montage	ca.		%
Klantenservice	ca.		%
Overige (administratie, inkoop, logistiek/distributie, onderhoud, productieplanning enz.)	ca.		%

=100%

10 **Hoe belangrijk zijn de volgende factoren voor de concurrentiepositie van uw bedrijfsvestiging verdeeld over de volgende werkterreinen?** (geef met een score van 1 tot 6 de volgorde van belangrijkheid aan; 1 is het belangrijkst, gebruik elke score slechts één keer)

productprijs	productkwaliteit	innovatieve producten	aanpassing producten aan klantenwensen	tijdige levering/ korte levertijden	dienstverlening en service
○	○	○	○	○	○

11.1

bedrijfstak (bijv. textiel, chemische industrie, machinebouw, enz.)	**hoofdproduct(groep)**	**Aandeel van hoofdproduct(groep) in omzet**
		ca. ___ %

11.2 **Is uw bedrijfstak gericht op uw hoofdproduct(groep) leverancier van eindfabrikaten of een toeleverancier van onderdelen/materialen of bewerkingen?** (Kruis slechts één optie aan)

producent van eindfabrikaten		toeleverancier		aanbieder van bewerkingen
☐ voor consumenten	☐ voor bedrijven	☐ van systemen/ installaties	☐ van halffabricaten/ onderdelen	☐ aanbieder van bewerkingen (draaien, coaten, lassen, vermalen, e.a.)

11.3 **Als u uw hoofdproduct(groep) levert aan andere bedrijven (als eindfabrikant of toeleverancier), aan welke bedrijfstak levert u dan hoofdzakelijk?** (Kruis slechts één optie aan)

Machinebouw ☐ Chemische industrie ☐ Automotive industrie ☐ Elektro-techniek ☐ andere bedrijfstak, nl.: ___

11.4 **Welke van de volgende kenmerken is het meest van toepassing op uw hoofdproduct(groep)?**

Productontwikkeling (kruis slechts één optie aan)

- + Op specificatie van klant ☐
- + Voor een standaard programma waarbinnen klantspecifieke wensen gerealiseerd kunnen worden ☐
- + Voor een standaardprogramma, waaruit de klant kan kiezen ☐
- + Niet aanwezig in deze bedrijfsvestiging ☐

Fabricage/montage (kruis slechts één optie aan)

- + Na binnenkomst klantorder (make to order) ☐
- + Eindmontage van het product wordt uitgevoerd na binnenkomst klantorder (assemble to order) ☐
- + Op voorraad (make to stock) ☐
- + Niet aanwezig in deze bedrijfsvestiging ☐

Seriegrootte (kruis slechts één optie aan)

- + Enkelstuksproductie ☐
- + Kleine of middelgrote series (20-1.000 stuks per maand) ☐
- + Grote series (meer dan 1000 stuks per maand) ☐
- + Geen discrete productie (procesindustrie) ☐

Productcomplexiteit (kruis slechts één optie aan)

- + Eenvoudige producten ☐
- + Producten van middelgrote complexiteit ☐
- + Complexe producten ☐

12.1 **Welke van de volgende kenmerken is het meest van toepassing op uw hoofdproduct(groep) in 2008?**

Wat is de gemiddelde productietijd van uw hoofdproduct(groep)? (doorlooptijd vanaf moment dat opdracht binnenkomt bij productie tot gereed product) ca. ___ werk-dagen ca. ___ uren

Hoeveel tijd ligt er gemiddeld tussen binnenkomst van een klantorder en aflevering (levertijd) ca. ___ kalenderdagen

Hoeveel procent van de orders wordt op tijd afgeleverd? ca. ___ %

Hoeveel procent van uw productie moet na kwaliteitscontrole nabewerking ondergaan of geheel worden afgekeurd? ca. ___ %

12.2 **Hoe hebben zich in uw bedrijfsvestiging de productiekosten per eenheid product (eenheidskosten) zich ontwikkeld in 2008?**

Gedaald meer dan 10%	Gedaald 5 - 10%	Gedaald 0 - 5%	Gelijk gebleven	Gestegen 0 - 5%	Gestegen 5 - 10%	Gestegen met meer dan 10%
☐	☐	☐	☐	☐	☐	☐

12.3 **Heeft uw bedrijfsvestiging in 2008 uitgaven gedaan voor opleiding en training van personeel (uzelf incluis)?**

☐ nee ☐ ja → Totale uitgaven voor opleiding en training van personeel in 2008. ___ duizend €

Hier worden enkele gegevens over uw bedrijfsvestiging gevraagd:

Totaal aantal werknemers per 31-12 (tijdelijk personeel niet meegerekend) 2008 ☐☐☐☐☐ aantal 2006 ☐☐☐☐☐ aantal

Had uw bedrijfsvestiging tijdelijk personeel in dienst in 2008? ☐ nee ☐ ja → Hoeveel tijdelijke medewerkers waren er werkzaam in uw bedrijfsvestiging in 2008? ☐☐☐ aantal

	2008		2006	
Totaal omzet	☐☐☐☐,☐	Miljoen €	☐☐☐☐,☐	Miljoen €
Inkoop 2008 (ingekochte onderdelen, materialen en diensten)	☐☐☐☐,☐	Miljoen €		
Afschrijvingen op machines en installaties 2008 (zonder grond en gebouwen)	☐☐☐☐,☐	Miljoen €		
Personeelskosten als percentage van omzet (incl. loonnevenkosten)	☐☐ %		Jaar van oprichting, c.q. inschrijving bij de Kamer van Koophandel	☐☐☐☐
Graad van capaciteitsbenutting 2008	☐☐ %			

Rendement op de omzet (vóór belasting in 2008) ☐ negatief ☐ 0 tot 2% ☐ 2 tot 5% ☐ 5 tot 10% ☐ meer dan 10%

Heeft uw bedrijfsvestiging in 2008 onderzoek en ontwikkelingsactiviteiten (O&O) uitgevoerd of laten uitvoerendoor externe partners?

☐ nee ☐ ja → Uitgaven voor O&O in procenten van de omzet van 2008 ca ☐☐ %

Uitgaven voor O&O als percentage van de omzet die in uw bedrijfsvestiging zijn besteed, maar zijn uitgevoerd door externe partners (bijv. andere bedrijven, universiteiten of O&O-service verleners) ca ☐☐ %

Heeft uw bedrijfsvestiging ook O&O-werkzaamheden laten verrichten door externe partners (bijv. andere bedrijven, universiteiten of onderzoeksbureaus?

☐ nee ☐ ja → Welk deel van de uitgaven aan O&O, is verricht door uw eigen vestiging en welk deel is uitgevoerd door externe partners?

eigen vestiging ca ☐☐ %
externe partners ca ☐☐ %
} =100 %

Geef a.u.b. voor 2008 de herkomst van uw toeleveringen (inputs) aan en de bestemming van uw producten?

Inputs (onderdelen, materialen e.d.) afkomstig uit:		Producten verkocht in:	
binnenland ca ☐☐ %	} =100% van de inkoopwaarde	binnenland ca ☐☐ %	} =100% van de omzet
buitenland ca ☐☐ %		buitenland ca ☐☐ %	

Werkt uw bedrijfsvestiging samen met andere bedrijven op de volgende terreinen?
(Samenwerking =vrijwillige samenwerking die verder gaat dan eenmalige transacties tussen bedrijven)

Nee	Ontwikkeling van:	Ja	Frequentie van samenwerkingsprojecten: Zelden	Van tijd tot tijd	Vaak	Uw samenwerkingspartner(s) is (zijn) (meerdere opties mogelijk): Klant	Leverancier	Concurrent	Ander productiebedrijf	Dienstverlener	Onderzoeksinstituut, universiteit
☐	Nieuwe producten	☐→	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	Nieuwe technische productieprocessen	☐→	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	Nieuwe dienstverlening	☐→	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	Nieuwe organisatieconcepten	☐→	☐	☐	☐	☐	☐	☐	☐	☐	☐

Werkt uw bedrijfsvestiging samen met regionale, nationale of internationale partners?

Nee		Ja	Zelden	Van tijd tot tijd	Vaak
☐	Met regionale partners (< 50 km)	☐→	☐	☐	☐
☐	Nationale partners	☐→	☐	☐	☐
☐	Buitenlandse partners in Europa	☐→	☐	☐	☐
☐	Buitenlandse partners buiten Europa	☐→	☐	☐	☐

4.1 **Recentelijk zijn nieuwe technologieën ter vermindering van het energieverbruik en het gebruik van grondstoffen een belangrijk aandachtspunt geworden. Welke van de volgende technologieën of concepten worden momenteel toegepast in uw bedrijfsvestiging?**

nee	Technologieën/Concepten	ja	omvang toegepaste potentieel[1] (g=gering/m=midden/h=hoog)	nee	Technologieën/Concepten	ja	omvang toegepaste potentieel[1] (g=gering/m=midden/h=hoog)
☐	Controlesystemen die machines stilleggen buiten piektijden	☐ →	g m h	☐	Terugwinning van kinetische en procesenergie	☐ →	g m h
☐	Electrische motoren met snelheidsregulering	☐ →	g m h	☐	Warmtekrachtkoppeling (bi-/trigeneratie)	☐ →	g m h
☐	Persluchtcontracting (inkoop perslucht)	☐ →	g m h	☐	Gebruik van afvalproducten voor eigen energie-opwekking	☐ →	g m h
☐	Toepassing van hoge-rendementspompen	☐ →	g m h	☐	Gebruik van gerecycelde materialen bij de productie	☐ →	g m h
☐	Lage-temperatuurprocessen	☐ →	g m h	☐	Hergebruik van producten aan het eindvan hun levenscyclus	☐ →	g m h

[1] **Toelichting:**
Daadwerkelijke toepassing ten opzichte van maximaal zinvolle toepassingsmogelijkheden in uw bedrijf: omvang van het toegepaste potentieel **"gering"** bij eerste poging, **"midden"** bij gedeeltelijke toepassing en **"hoog"** omvangrijke toepassing.

4.2a **Maakt u gebruik van milieu-monitoringsystemen (bijv. EN ISO 14031 enz.)?**

☐ nee ☐ ja Voor het eerst toegepast (jaar) 19/20 ☐☐

4.2b **Hoe hoog waren de uitgaven van uw bedrijfsvestiging aan energie in 2008 (electriciteit, olie, gas etc.)?**

☐☐☐☐☐ duizend euro

4.3 **Werkt u op het gebied van energiegebruik het hergebruik van afvalstoffen samen met andere bedrijfsvestigingen of ondernemingen?**
(samenwerking= duurzame samenwerking die verder gaat dan afzonderlijke marktrelaties)

	Nee	Ja		Nee	Ja
Betrekken/leveren van industriële restwarmte van resp. aan andere bedrijfsvestigingen/ondernemingen (in de context van een gezamenlijk netwerk)	☐	☐	Betrekken/leveren van industriële afvalstoffen van resp. aan andere bedrijfsvestigingen/ondernemingen (recycling- of daaraan verwante bedrijven niet meegerekend)	☐	☐

4.4 **Maak a.u.b. een inschatting van de efficientie van uw productie in termen van energie- en grondstoffenverbruik ten opzchte van andere bedrijfsvestigingen in uw branche** (1=inefficient; 5= zeer efficient).

aanzienlijke minder efficiënt	enigszins minder efficiënt	even efficiënt	enigszins efficiënter	veel efficiënter
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

4.5 **Welk deel van uw actuele energie- en grondstoffenverbruik zou u kunnen besparen indien u alle beschikbare technologische mogelijkheden zou aanwenden?**
(stel het huidige energie- en grondstoffenverbruik van uw bedrijfsvestiging op 100%)

Potentiële besparing op energie (electriciteit, olie, gas enz.), ☐☐ %

Potentiële besparing op grondstoffen ☐☐ %

U kunt de vragenlijst retourneren in de antwoordenvelop of opsturen naar Radboud Universiteit, Faculteit Managementwetenschappen, t.n.v. Dr P. Vaessen, Antwoordnummer 1908, 6500 VC Nijmegen

Indien u prijs stelt op inzage in de onderzoeksresultaten en de mogelijkheid uw eigen bedrijf on line te vergelijken met relevante groepen bedrijven, dan verzoeken wij u uw adresgegevens en e-mail hier in te vullen.

Mevr./dhr.

Bedrijfsnaam

Adres
Postcode, Plaats

E-mail adres

Appendix D – SPSS output

Sample characteristics

Frequencies:

Statistics

		Firm independence	Product innovation	Product innovation (newness)	Industry	Multinationality
N	Valid	327	331	331	326	327
	Missing	4	0	0	5	4

Firm independence

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	subsidiary	86	26,0	26,3	26,3
	stand-alone	182	55,0	55,7	82,0
	HQ	59	17,8	18,0	100,0
	Total	327	98,8	100,0	
Missing	System	4	1,2		
Total		331	100,0		

Product innovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	165	49,8	49,8	49,8
	yes	166	50,2	50,2	100,0
	Total	331	100,0	100,0	

Product innovation (newness)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no innovation	165	49,8	49,8	49,8
	only NTTF innovation	67	20,2	20,2	70,1
	NTTM innovation	99	29,9	29,9	100,0
	Total	331	100,0	100,0	

Industry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	metals	71	21,5	21,8	21,8
	food	34	10,3	10,4	32,2
	textiles	24	7,3	7,4	39,6
	construction	54	16,3	16,6	56,1
	chemicals	46	13,9	14,1	70,2
	machinery	62	18,7	19,0	89,3
	electronics	24	7,3	7,4	96,6
	transport	11	3,3	3,4	100,0
	Total	326	98,5	100,0	
Missing	System	5	1,5		
Total		331	100,0		

Multinationality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	domestic	231	69,8	70,6	70,6
	multinational	96	29,0	29,4	100,0
	Total	327	98,8	100,0	
Missing	System	4	1,2		
Total		331	100,0		

Descriptive Statistics:

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Firm age [years]	255	1	173	37,19	1,920	30,660	940,053	1,605	,153	2,897	,304
Process innovation	321	,00	12,00	2,0498	,11081	1,98526	3,941	1,435	,136	3,279	,271
Share of personnel in R&D	323	0	70	5,80	,451	8,098	65,572	3,299	,136	16,971	,271
Firm size [employees]	331	10	3000	63,90	9,778	177,887	31643,900	13,958	,134	226,579	,267
Valid N (listwise)	244										

Mann-Whitney Test:

Ranks

	Product innovation	N	Mean Rank	Sum of Ranks
Share of personnel in R&D	no	162	128,81	20867,00
	yes	161	195,40	31459,00
	Total	323		
Firm size [employees]	no	165	150,06	24760,50
	yes	166	181,84	30185,50
	Total	331		

Test Statistics[a]

			Share of personnel in R&D	Firm size [employees]
Mann-Whitney U			7664,000	11065,500
Wilcoxon W			20867,000	24760,500
Z			-6,552	-3,021
Asymp. Sig. (2-tailed)			,000	,003
Monte Carlo Sig. (2-tailed)	Sig.		,000[b]	,003[b]
	99% Confidence Interval	Lower Bound	,000	,001
		Upper Bound	,000	,004
Monte Carlo Sig. (1-tailed)	Sig.		,000[b]	,001[b]
	99% Confidence Interval	Lower Bound	,000	,000
		Upper Bound	,000	,002

a. Grouping Variable: Product innovation

b. Based on 10000 sampled tables with starting seed 2000000.

Kruskal-Wallis Test:

Ranks

	Product innovation (newness)	N	Mean Rank
Firm size [employees]	no innovation	165	150,06
	only NTTF innovation	67	177,78
	NTTM innovation	99	184,59
	Total	331	
Share of personnel in R&D	no innovation	162	128,81
	only NTTF innovation	67	180,17
	NTTM innovation	94	206,25
	Total	323	

Test Statistics[a,b]

			Firm size [employees]	Share of personnel in R&D
Chi-Square			9,331	46,119
df			2	2
Asymp. Sig.			,009	,000
Monte Carlo Sig.	Sig.		,010[c]	,000[c]
	99% Confidence Interval	Lower Bound	,007	,000
		Upper Bound	,012	,000

a. Kruskal Wallis Test

b. Grouping Variable: Product innovation (newness)

c. Based on 10000 sampled tables with starting seed 1502173562.

Binary logistic regression:

Classification Table[a]

			Predicted		
			Product innovation		Percentage Correct
	Observed		no	yes	
Step 1	Product innovation	no	125	37	77,2
		yes	87	74	46,0
	Overall Percentage				61,6

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Share of personnel in R&D	,086	,021	16,891	1	,000	1,090
	Firm size [employees]	,002	,002	1,836	1	,175	1,002
	Constant	-,590	,174	11,468	1	,001	,554

a. Variable(s) entered on step 1: Share of personnel in R&D, Firm size [employees].

Multinomial logistic regression:

Likelihood Ratio Tests

Effect	Model Fitting Criteria: -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests: Chi-Square	df	Sig.
Intercept	611,934	63,490	2	,000
Firm size [employees]	552,005	3,562	2	,168
Share of personnel in R&D	571,860	23,416	2	,000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Mann-Whitney Test - after log transformation of firm size:

Ranks

	Product innovation	N	Mean Rank	Sum of Ranks
Share of personnel in R&D	no	162	128,81	20867,00
	yes	161	195,40	31459,00
	Total	323		
Ln firm size	no	165	150,06	24760,50
	yes	166	181,84	30185,50
	Total	331		

Test Statistics[a]

			Share of personnel in R&D	Ln firm size
Mann-Whitney U			7664,000	11065,500
Wilcoxon W			20867,000	24760,500
Z			-6,552	-3,021
Asymp. Sig. (2-tailed)			,000	,003
Monte Carlo Sig. (2-tailed)	Sig.		,000[b]	,003[b]
	99% Confidence Interval	Lower Bound	,000	,001
		Upper Bound	,000	,004
Monte Carlo Sig. (1-tailed)	Sig.		,000[b]	,001[b]
	99% Confidence Interval	Lower Bound	,000	,000
		Upper Bound	,000	,002

a. Grouping Variable: Product innovation

b. Based on 10000 sampled tables with starting seed 1310155034.

Kruskal-Wallis Test – after log transformation of firm size:

Ranks

	Product innovation (newness)	N	Mean Rank
Share of personnel in R&D	no innovation	162	128,81
	only NTTF innovation	67	180,17
	NTTM innovation	94	206,25
	Total	323	
Ln firm size	no innovation	165	150,06
	only NTTF innovation	67	177,78
	NTTM innovation	99	184,59
	Total	331	

Test Statistics[a,b]

			Share of personnel in R&D	Ln firm size
Chi-Square			46,119	9,331
df			2	2
Asymp. Sig.			,000	,009
Monte Carlo Sig.	Sig.		,000[c]	,011[c]
	99% Confidence Interval	Lower Bound	,000	,008
		Upper Bound	,000	,013

a. Kruskal Wallis Test

b. Grouping Variable: Product innovation (newness)

c. Based on 10000 sampled tables with starting seed 113410539.

Binary logistic regression – after log transformation of firm size:

Classification Table[a]

			Predicted		
			Product innovation		Percentage Correct
	Observed		no	yes	
Step 1	Product innovation	no	118	44	72,8
		yes	73	88	54,7
	Overall Percentage				63,8

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Ln firm size	,334	,138	5,856	1	,016	1,397
	Share of personnel in R&D	,086	,021	16,625	1	,000	1,089
	Constant	-1,650	,511	10,430	1	,001	,192

a. Variable(s) entered on step 1: Ln firm size, Share of personnel in R&D.

Multinomial logistic regression – after log transformation of firm size:

Likelihood Ratio Tests

Effect	Model Fitting Criteria: -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests: Chi-Square	df	Sig.
Intercept	568,119	22,529	2	,000
Share of personnel in R&D	568,388	22,799	2	,000
Ln firm size	552,005	6,416	2	,040

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Descriptive Statistics - after log transformation of firm size:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Firm age [years]	255	1	173	37,19	30,660	1,605	,153	2,897	,304
Process innovation	321	,00	12,00	2,0498	1,98526	1,435	,136	3,279	,271
Share of personnel in R&D	323	0	70	5,80	8,098	3,299	,136	16,971	,271
Ln firm size	331	2,30	8,01	3,5708	,89109	1,069	,134	1,692	,267
Valid N (listwise)	244								

Assumptions of logistic regression

Linearity assumption – binary logistic regression:

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Firm independence			2,609	2	,271	
	Firm independence(1)	-1,096	,749	2,139	1	,144	,334
	Firm independence(2)	,005	,849	,000	1	,995	1,005
	Firm independence * Firm age [years]			7,299	2	,026	
	Firm independence(1) by Firm age [years]	,025	,013	3,704	1	,054	1,025
	Firm independence(2) by Firm age [years]	-,016	,019	,738	1	,390	,984
	Industry			6,254	7	,510	
	Industry(1)	-,762	,888	,737	1	,391	,467
	Industry(2)	,485	,973	,249	1	,618	1,625
	Industry(3)	,321	1,024	,098	1	,754	1,378
	Industry(4)	-,214	,904	,056	1	,813	,807
	Industry(5)	-,052	,912	,003	1	,955	,949
	Industry(6)	-,331	,907	,133	1	,715	,718
	Industry(7)	,366	1,171	,098	1	,755	1,442
	Multinationality(1)	-,234	,556	,177	1	,674	,791
	Process innovation	-,206	,389	,280	1	,597	,814
	Share of personnel in R&D	,374	,138	7,298	1	,007	1,453
	Ln firm size	2,975	2,577	1,332	1	,248	19,584
	Firm age [years]	,204	,070	8,423	1	,004	1,227
	Ln process innovation by Process innovation	,168	,210	,640	1	,424	1,183
	Ln personnel R&D by Share of personnel in R&D	-,081	,043	3,540	1	,060	,922
	Ln_Ln_firm_size by Ln firm size	-1,079	1,086	,986	1	,321	,340
	Ln firm age by Firm age [years]	-,045	,014	9,619	1	,002	,956
	Constant	-7,255	4,416	2,698	1	,100	,001

a. Variable(s) entered on step 1: Firm independence, Firm independence * Firm age [years] , Industry, Multinationality, Process innovation, Share of personnel in R&D, Ln firm size, Firm age [years], Ln process innovation * Process innovation , Ln personnel R&D * Share of personnel in R&D , Ln_Ln_firm_size * Ln firm size , Ln firm age * Firm age [years] .

Linearity assumption – multinomial logistic regression:

Likelihood Ratio Tests

Effect	Model Fitting Criteria: -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests: Chi-Square	df	Sig.
Intercept	392,924[a]	,000	0	.
Firm independence	398,869	5,944	4	,203
Industry	408,503	15,578	14	,340
Multinationality	393,198	,274	2	,872
Process innovation	393,654	,730	2	,694
Share of personnel in R&D	401,831	8,907	2	,012
Ln firm size	394,342	1,418	2	,492
Firm age [years]	392,924[a]	,000	0	.
Firm independence * Firm age [years]	401,600	8,676	4	,070
Process innovation * Ln process innovation	393,168	,244	2	,885
Share of personnel in R&D * Ln personnel R&D	397,827	4,902	2	,086
Ln firm size * Ln_Ln_firm_size	393,998	1,074	2	,585
Firm age [years] * Ln firm age	403,869	10,944	2	,004

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Multicollinearity assumption – binary logistic regression:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	,065	,187		,348	,728		
	Industry	,018	,016	,075	1,128	,260	,852	1,174
	Multinationality	-,030	,080	-,028	-,380	,704	,700	1,428
	Firm independence	-,022	,051	-,028	-,427	,669	,892	1,121
	Process innovation	,010	,018	,039	,572	,568	,836	1,196
	Share of personnel in R&D	,018	,005	,258	3,772	,000	,815	1,227
	Firm age [years]	-,001	,001	-,043	-,668	,505	,934	1,071
	Ln firm size	,091	,042	,169	2,168	,031	,627	1,594

a. Dependent Variable: Product innovation

Multicollinearity assumption – multinomial logistic regression:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-,063	,322		-,194	,846		
	Industry	,033	,027	,079	1,193	,234	,852	1,174
	Multinationality	-,068	,138	-,036	-,493	,622	,700	1,428
	Firm independence	,006	,087	,005	,071	,943	,892	1,121
	Process innovation	,057	,031	,122	1,837	,068	,836	1,196
	Share of personnel in R&D	,031	,008	,264	3,918	,000	,815	1,227
	Firm age [years]	-,001	,002	-,036	-,574	,566	,934	1,071
	Ln firm size	,140	,072	,149	1,942	,053	,627	1,594

a. Dependent Variable: Product innovation (newness)

Independence of errors – binary logistic regression:

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,362[a]	,131	,104	,474	2,021

a. Predictors: (Constant), Ln firm size, Share of personnel in R&D, Firm age [years], Firm independence, Industry, Process innovation, Multinationality

b. Dependent Variable: Product innovation

Independence of errors – multinomial logistic regression:

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,395[a]	,156	,130	,81723	1,966

a. Predictors: (Constant), Ln firm size, Share of personnel in R&D, Firm age [years], Firm independence, Industry, Process innovation, Multinationality

b. Dependent Variable: Product innovation (newness)

Overdispersion – binary logistic regression:

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	229,596	218	,282
Deviance	273,391	218	,006

Overdispersion – multinomial logistic regression:

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	448,055	436	,335
Deviance	408,196	436	,826

Binary logistic regression

Model 0:

Categorical Variables Codings

			Parameter coding						
		Frequency	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Industry	metals	55	1,000	,000	,000	,000	,000	,000	,000
	food	24	,000	1,000	,000	,000	,000	,000	,000
	textiles	19	,000	,000	1,000	,000	,000	,000	,000
	construction	40	,000	,000	,000	1,000	,000	,000	,000
	chemicals	34	,000	,000	,000	,000	1,000	,000	,000
	machinery	43	,000	,000	,000	,000	,000	1,000	,000
	electronics	13	,000	,000	,000	,000	,000	,000	1,000
	transport	8	,000	,000	,000	,000	,000	,000	,000
Firm independence	subsidiary	65	,000	,000					
	stand-alone	134	1,000	,000					
	HQ	37	,000	1,000					
Multinationality	domestic	163	,000						
	multinational	73	1,000						

Iteration History[a,b,c]

Iteration		-2 Log likelihood	Coefficients Constant
Step 0	1	327,149	,017
	2	327,149	,017

a. Constant is included in the model.

b. Initial -2 Log Likelihood: 327,149

c. Estimation terminated at iteration number 2 because parameter estimates changed by less than ,001.

Classification Table[a,b]

			Predicted		
			Product innovation		Percentage Correct
	Observed		no	yes	
Step 0	Product innovation	no	0	117	,0
		yes	0	119	100,0
	Overall Percentage				50,4

a. Constant is included in the model.

b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,017	,130	,017	1	,896	1,017

Model 1:

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	38,789	12	,000
	Block	38,789	12	,000
	Model	38,789	12	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	288,360[a]	,152	,202

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Classification Table[a]

			Predicted		
			Product innovation		Percentage Correct
	Observed		no	yes	
Step 1	Product innovation	no	81	36	69,2
		yes	48	71	59,7
	Overall Percentage				64,4

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Multinationality(1)	-,215	,374	,330	1	,566	,807	,387	1,680
	Industry			3,717	7	,812			
	Industry(1)	-,694	,857	,657	1	,418	,499	,093	2,676
	Industry(2)	,041	,916	,002	1	,965	1,041	,173	6,276
	Industry(3)	-,513	,955	,289	1	,591	,599	,092	3,888
	Industry(4)	-,298	,869	,118	1	,732	,742	,135	4,079
	Industry(5)	,075	,879	,007	1	,932	1,078	,192	6,041
	Industry(6)	-,352	,875	,162	1	,687	,703	,127	3,905
	Industry(7)	-,150	1,085	,019	1	,890	,861	,103	7,217
	Firm age [years]	-,004	,005	,614	1	,433	,996	,986	1,006
	Ln firm size	,460	,199	5,319	1	,021	1,584	1,072	2,342
	Share of personnel in R&D	,108	,029	13,721	1	,000	1,114	1,052	1,179
	Process innovation	,076	,089	,720	1	,396	1,079	,906	1,285
	Constant	-1,824	1,053	2,998	1	,083	,161		

a. Variable(s) entered on step 1: Multinationality, Industry, Firm age [years], Ln firm size, Share of personnel in R&D, Process innovation.

Model 2:

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	,508	2	,776
	Block	,508	2	,776
	Model	39,296	14	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	287,852[a]	,153	,205

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Classification Table[a]

			Predicted		
			Product innovation		Percentage Correct
	Observed		no	yes	
Step 1	Product innovation	no	82	35	70,1
		yes	48	71	59,7
	Overall Percentage				64,8

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Multinationality(1)	-,088	,512	,029	1	,864	,916	,336	2,498
	Industry			3,779	7	,805			
	Industry(1)	-,681	,858	,632	1	,427	,506	,094	2,716
	Industry(2)	,101	,918	,012	1	,913	1,106	,183	6,689
	Industry(3)	-,479	,955	,252	1	,616	,619	,095	4,027
	Industry(4)	-,263	,868	,092	1	,762	,768	,140	4,214
	Industry(5)	,082	,876	,009	1	,926	1,085	,195	6,046
	Industry(6)	-,316	,876	,130	1	,718	,729	,131	4,062
	Industry(7)	-,081	1,099	,005	1	,942	,923	,107	7,950
	Firm age [years]	-,004	,005	,519	1	,471	,996	,987	1,006
	Ln firm size	,456	,206	4,905	1	,027	1,578	1,054	2,364
	Share of personnel in R&D	,110	,030	13,845	1	,000	1,116	1,053	1,183
	Process innovation	,071	,090	,611	1	,435	1,073	,899	1,281
	Firm independence			,505	2	,777			
	Firm independence(1)	,072	,521	,019	1	,891	1,074	,387	2,982
	Firm independence(2)	-,259	,477	,295	1	,587	,772	,303	1,966
	Constant	-1,889	1,178	2,573	1	,109	,151		

a. Variable(s) entered on step 1: Firm independence.

Model 3:

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12,196	4	,016
	Block	12,196	4	,016
	Model	50,985	16	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	276,164[a]	,194	,259

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than ,001.

Classification Table[a]

Observed			Predicted: Product innovation no	Predicted: Product innovation yes	Percentage Correct
Step 1	Product innovation	no	78	39	66,7
		yes	43	76	63,9
	Overall Percentage				65,3

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Multinationality(1)	-,286	,537	,284	1	,594	,751	,262	2,153
	Industry			3,831	7	,799			
	Industry(1)	-,616	,866	,506	1	,477	,540	,099	2,950
	Industry(2)	,339	,943	,129	1	,720	1,403	,221	8,915
	Industry(3)	-,169	,979	,030	1	,863	,845	,124	5,750
	Industry(4)	-,115	,880	,017	1	,896	,892	,159	5,006
	Industry(5)	,043	,885	,002	1	,962	1,044	,184	5,918
	Industry(6)	-,170	,889	,037	1	,848	,843	,148	4,815
	Industry(7)	,068	1,118	,004	1	,952	1,070	,119	9,580
	Firm age [years]	-,017	,009	3,666	1	,056	,984	,967	1,000
	Ln firm size	,498	,214	5,440	1	,020	1,646	1,083	2,503
	Share of personnel in R&D	,122	,031	15,683	1	,000	1,129	1,063	1,199
	Process innovation	,084	,093	,814	1	,367	1,088	,906	1,306
	Firm independence			3,859	2	,145			
	Firm independence(1)	-1,187	,700	2,880	1	,090	,305	,077	1,202
	Firm independence(2)	,171	,800	,046	1	,830	1,187	,247	5,697
	Firm independence * Firm age [years]			10,445	2	,005			
	Firm independence(1) by Firm age [years]	,030	,011	6,882	1	,009	1,030	1,008	1,054
	Firm independence(2) by Firm age [years]	-,014	,017	,655	1	,418	,987	,955	1,019
	Constant	-1,546	1,223	1,598	1	,206	,213		

a. Variable(s) entered on step 1: Firm independence, Firm independence * Firm age [years] .

Multinomial logistic regression

Model 1:

Case Processing Summary

		N	Marginal Percentage
Product innovation (newness)	no innovation	117	49,6%
	only NTTF innovation	47	19,9%
	NTTM innovation	72	30,5%
Multinationality	domestic	163	69,1%
	multinational	73	30,9%
Industry	metals	55	23,3%
	food	24	10,2%
	textiles	19	8,1%
	construction	40	16,9%
	chemicals	34	14,4%
	machinery	43	18,2%
	electronics	13	5,5%
	transport	8	3,4%
Valid		236	100,0%
Missing		95	
Total		331	
Subpopulation		235[a]	

a. The dependent variable has only one value observed in 234 (99,6%) subpopulations.

Model Fitting Information

	Model Fitting Criteria			Likelihood Ratio Tests		
Model	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	489,440	496,367	485,440			
Final	478,653	568,713	426,653	58,787	24	,000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	461,859	444	,270
Deviance	425,267	444	,731

Pseudo R-Square

Cox and Snell	,220
Nagelkerke	,253
McFadden	,121

Likelihood Ratio Tests

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	478,653	568,713	426,653[a]	,000	0	.
Multinationality	475,771	558,903	427,771	1,118	2	,572
Industry	461,974	503,540	437,974	11,321	14	,661
Process innovation	486,729	569,861	438,729	12,076	2	,002
Share of personnel in R&D	493,067	576,199	445,067	18,414	2	,000
Ln firm size	480,207	563,339	432,207	5,554	2	,062
Firm age [years]	475,343	558,475	427,343	,690	2	,708

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates

Product innovation (newness)[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
only NTTF innovation	Intercept	-2,080	1,413	2,169	1	,141			
	[Multinationality=,00]	-,082	,476	,030	1	,863	,921	,363	2,341
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,559	1,016	,303	1	,582	,572	,078	4,190
	[Industry=2,00]	-,389	1,128	,119	1	,730	,678	,074	6,178
	[Industry=3,00]	-,611	1,168	,274	1	,601	,543	,055	5,352
	[Industry=4,00]	-,013	1,022	,000	1	,990	,987	,133	7,324
	[Industry=5,00]	-,637	1,085	,344	1	,557	,529	,063	4,439
	[Industry=6,00]	-,420	1,042	,162	1	,687	,657	,085	5,067
	[Industry=7,00]	,095	1,264	,006	1	,940	1,100	,092	13,108
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	Process innovation	-,172	,125	1,897	1	,168	,842	,658	1,076
	Share of personnel in R&D	,086	,034	6,480	1	,011	1,090	1,020	1,164
	Ln firm size	,450	,248	3,312	1	,069	1,569	,966	2,549
	Firm age [years]	-,004	,006	,309	1	,578	,996	,984	1,009
NTTM innovation	Intercept	-3,207	1,360	5,559	1	,018			
	[Multinationality=,00]	,392	,436	,806	1	,369	1,479	,629	3,479
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,794	,986	,648	1	,421	,452	,066	3,121
	[Industry=2,00]	,349	1,042	,112	1	,738	1,418	,184	10,934
	[Industry=3,00]	-,410	1,105	,138	1	,711	,664	,076	5,789
	[Industry=4,00]	-,606	1,005	,363	1	,547	,546	,076	3,912
	[Industry=5,00]	,460	,990	,216	1	,642	1,584	,228	11,030
	[Industry=6,00]	-,301	,989	,092	1	,761	,740	,106	5,147
	[Industry=7,00]	-,386	1,226	,099	1	,753	,680	,062	7,514
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	Process innovation	,229	,103	4,920	1	,027	1,258	1,027	1,540
	Share of personnel in R&D	,123	,032	14,661	1	,000	1,131	1,062	1,204
	Ln firm size	,473	,231	4,179	1	,041	1,604	1,020	2,524
	Firm age [years]	-,004	,006	,570	1	,450	,996	,984	1,007

a. The reference category is: no innovation.

b. This parameter is set to zero because it is redundant.

Model 2:

Case Processing Summary

		N	Marginal Percentage
Product innovation (newness)	no innovation	117	49,6%
	only NTTF innovation	47	19,9%
	NTTM innovation	72	30,5%
Firm independence (rc standalone)	HQ	37	15,7%
	subsidiary	65	27,5%
	standalone	134	56,8%
Industry	metals	55	23,3%
	food	24	10,2%
	textiles	19	8,1%
	construction	40	16,9%
	chemicals	34	14,4%
	machinery	43	18,2%
	electronics	13	5,5%
	transport	8	3,4%
Multinationality	domestic	163	69,1%
	multinational	73	30,9%
Valid		236	100,0%
Missing		95	
Total		331	
Subpopulation		235[a]	

a. The dependent variable has only one value observed in 234 (99,6%) subpopulations.

Model Fitting Information

	Model Fitting Criteria			Likelihood Ratio Tests		
Model	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	489,440	496,367	485,440			
Final	481,945	585,860	421,945	63,494	28	,000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	457,681	440	,271
Deviance	420,559	440	,740

Pseudo R-Square

Cox and Snell	,236
Nagelkerke	,270
McFadden	,130

Likelihood Ratio Tests

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	481,945	585,860	421,945[a]	,000	0	.
Firm independence (rc standalone)	478,653	568,713	426,653	4,707	4	,319
Industry	466,747	522,168	434,747	12,802	14	,542
Multinationality	478,248	575,235	422,248	,303	2	,860
Ln firm size	483,445	580,433	427,445	5,500	2	,064
Firm age [years]	478,537	575,524	422,537	,591	2	,744
Share of personnel in R&D	496,400	593,388	440,400	18,455	2	,000
Process innovation	488,255	585,242	432,255	10,309	2	,006

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Reference category: subsidiaries

Parameter Estimates

Product innovation (newness)[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
only NTTF innovation	Intercept	-1,689	1,445	1,366	1	,242			
	[Firm independence (rc sub)=1,00]	-,651	,614	1,125	1	,289	,522	,157	1,736
	[Firm independence (rc sub)=2,00]	-,712	,594	1,435	1	,231	,491	,153	1,573
	[Firm independence (rc sub)=3,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,426	1,020	,174	1	,676	,653	,089	4,822
	[Industry=2,00]	-,289	1,132	,065	1	,799	,749	,081	6,894
	[Industry=3,00]	-,488	1,170	,174	1	,677	,614	,062	6,085
	[Industry=4,00]	,075	1,025	,005	1	,942	1,078	,145	8,035
	[Industry=5,00]	-,647	1,084	,356	1	,551	,524	,063	4,388
	[Industry=6,00]	-,283	1,048	,073	1	,787	,754	,097	5,876
	[Industry=7,00]	,292	1,283	,052	1	,820	1,339	,108	16,550
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	,207	,612	,115	1	,735	1,230	,371	4,079
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	Ln firm size	,384	,259	2,206	1	,137	1,468	,885	2,437
	Firm age [years]	-,004	,006	,420	1	,517	,996	,983	1,009
	Share of personnel in R&D	,090	,034	6,988	1	,008	1,094	1,024	1,170
	Process innovation	-,170	,127	1,776	1	,183	,844	,657	1,083
NTTM innovation	Intercept	-3,418	1,397	5,987	1	,014			
	[Firm independence (rc sub)=1,00]	,835	,694	1,449	1	,229	2,306	,592	8,986
	[Firm independence (rc sub)=2,00]	,196	,566	,120	1	,729	1,216	,401	3,688
	[Firm independence (rc sub)=3,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,934	,993	,885	1	,347	,393	,056	2,753
	[Industry=2,00]	,342	1,046	,107	1	,743	1,408	,181	10,940
	[Industry=3,00]	-,484	1,110	,190	1	,663	,616	,070	5,429
	[Industry=4,00]	-,722	1,013	,508	1	,476	,486	,067	3,540
	[Industry=5,00]	,404	,991	,166	1	,684	1,498	,215	10,445
	[Industry=6,00]	-,413	,999	,171	1	,679	,662	,093	4,683
	[Industry=7,00]	-,482	1,241	,151	1	,698	,618	,054	7,030
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	-,199	,662	,090	1	,764	,820	,224	2,997
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	Ln firm size	,524	,238	4,853	1	,028	1,689	1,060	2,693
	Firm age [years]	-,003	,006	,341	1	,559	,997	,985	1,008
	Share of personnel in R&D	,123	,032	14,475	1	,000	1,131	1,062	1,205
	Process innovation	,212	,105	4,119	1	,042	1,237	1,007	1,518

a. The reference category is: no innovation.

b. This parameter is set to zero because it is redundant.

Reference category: stand-alone

Parameter Estimates

Product innovation (newness)[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
only NTTF innovation	Intercept	-2,340	1,461	2,566	1	,109			
	[Firm independence (rc standalone)=1,00]	-,061	,629	,009	1	,922	,941	,274	3,227
	[Firm independence (rc standalone)=2,00]	,651	,614	1,125	1	,289	1,917	,576	6,381
	[Firm independence (rc standalone)=3,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,426	1,020	,174	1	,676	,653	,089	4,822
	[Industry=2,00]	-,289	1,132	,065	1	,799	,749	,081	6,894
	[Industry=3,00]	-,488	1,170	,174	1	,677	,614	,062	6,085
	[Industry=4,00]	,075	1,025	,005	1	,942	1,078	,145	8,035
	[Industry=5,00]	-,647	1,084	,356	1	,551	,524	,063	4,388
	[Industry=6,00]	-,283	1,048	,073	1	,787	,754	,097	5,876
	[Industry=7,00]	,292	1,283	,052	1	,820	1,339	,108	16,550
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	,207	,612	,115	1	,735	1,230	,371	4,079
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	Ln firm size	,384	,259	2,206	1	,137	1,468	,885	2,437
	Firm age [years]	-,004	,006	,420	1	,517	,996	,983	1,009
	Share of personnel in R&D	,090	,034	6,988	1	,008	1,094	1,024	1,170
	Process innovation	-,170	,127	1,776	1	,183	,844	,657	1,083
NTTM innovation	Intercept	-2,582	1,453	3,159	1	,076			
	[Firm independence (rc standalone)=1,00]	-,639	,645	,982	1	,322	,528	,149	1,869
	[Firm independence (rc standalone)=2,00]	-,835	,694	1,449	1	,229	,434	,111	1,690
	[Firm independence (rc standalone)=3,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,934	,993	,885	1	,347	,393	,056	2,753
	[Industry=2,00]	,342	1,046	,107	1	,743	1,408	,181	10,940
	[Industry=3,00]	-,484	1,110	,190	1	,663	,616	,070	5,429
	[Industry=4,00]	-,722	1,013	,508	1	,476	,486	,067	3,540
	[Industry=5,00]	,404	,991	,166	1	,684	1,498	,215	10,445
	[Industry=6,00]	-,413	,999	,171	1	,679	,662	,093	4,683
	[Industry=7,00]	-,482	1,241	,151	1	,698	,618	,054	7,030
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	-,199	,662	,090	1	,764	,820	,224	2,997
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	Ln firm size	,524	,238	4,853	1	,028	1,689	1,060	2,693
	Firm age [years]	-,003	,006	,341	1	,559	,997	,985	1,008
	Share of personnel in R&D	,123	,032	14,475	1	,000	1,131	1,062	1,205
	Process innovation	,212	,105	4,119	1	,042	1,237	1,007	1,518

a. The reference category is: no innovation.

b. This parameter is set to zero because it is redundant.

Model 3:

Case Processing Summary

		N	Marginal Percentage
Product innovation (newness)	no innovation	117	49,6%
	only NTTF innovation	47	19,9%
	NTTM innovation	72	30,5%
Firm independence (rc standalone)	HQ	37	15,7%
	subsidiary	65	27,5%
	standalone	134	56,8%
Multinationality	domestic	163	69,1%
	multinational	73	30,9%
Industry	metals	55	23,3%
	food	24	10,2%
	textiles	19	8,1%
	construction	40	16,9%
	chemicals	34	14,4%
	machinery	43	18,2%
	electronics	13	5,5%
	transport	8	3,4%
Valid		236	100,0%
Missing		95	
Total		331	
Subpopulation		235[a]	

a. The dependent variable has only one value observed in 234 (99,6%) subpopulations.

Model Fitting Information

	Model Fitting Criteria			Likelihood Ratio Tests		
Model	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	489,440	496,367	485,440			
Final	477,582	595,352	409,582	75,858	32	,000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	448,055	436	,335
Deviance	408,196	436	,826

Pseudo R-Square

Cox and Snell	,275
Nagelkerke	,315
McFadden	,156

Likelihood Ratio Tests

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	477,582	595,352	409,582[a]	,000	0	.
Firm independence (rc standalone)	477,405	581,320	417,405	7,823	4	,098
Multinationality	473,896	584,738	409,896	,314	2	,855
Industry	462,773	532,050	422,773	13,191	14	,512
Process innovation	484,033	594,875	420,033	10,450	2	,005
Share of personnel in R&D	494,629	605,471	430,629	21,047	2	,000
Ln firm size	479,555	590,398	415,555	5,973	2	,050
Firm age [years]	477,582	595,352	409,582[a]	,000	0	.
Firm independence (rc standalone) * Firm age [years]	481,945	585,860	421,945	12,363	4	,015

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Reference category: subsidiaries

Parameter Estimates

Product innovation (newness)[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
only NTTF innovation	Intercept	-1,442	1,506	,917	1	,338			
	[Firm independence (rc sub)=1,00]	-2,006	,833	5,796	1	,016	,135	,026	,689
	[Firm independence (rc sub)=2,00]	-,584	1,016	,331	1	,565	,557	,076	4,085
	[Firm independence (rc sub)=3,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	,346	,631	,301	1	,583	1,414	,411	4,869
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,373	1,035	,130	1	,719	,689	,091	5,233
	[Industry=2,00]	-,014	1,155	,000	1	,990	,986	,103	9,478
	[Industry=3,00]	-,173	1,198	,021	1	,885	,841	,080	8,801
	[Industry=4,00]	,253	1,043	,059	1	,808	1,288	,167	9,942
	[Industry=5,00]	-,722	1,102	,429	1	,513	,486	,056	4,215
	[Industry=6,00]	-,175	1,069	,027	1	,870	,839	,103	6,823
	[Industry=7,00]	,453	1,313	,119	1	,730	1,572	,120	20,624
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	Process innovation	-,156	,130	1,437	1	,231	,856	,663	1,104
	Share of personnel in R&D	,102	,035	8,316	1	,004	1,107	1,033	1,187
	Ln firm size	,422	,266	2,525	1	,112	1,525	,906	2,566
	Firm age [years]	-,019	,011	3,016	1	,082	,981	,960	1,002
	[Firm independence (rc sub)=1,00] * Firm age [years]	,034	,015	5,518	1	,019	1,035	1,006	1,065
	[Firm independence (rc sub)=2,00] * Firm age [years]	-,004	,022	,038	1	,846	,996	,954	1,039
	[Firm independence (rc sub)=3,00] * Firm age [years]	0[b]	.	.	0	.	.	.	.
NTTM innovation	Intercept	-3,377	1,449	5,429	1	,020			
	[Firm independence (rc sub)=1,00]	-,356	,874	,166	1	,683	,700	,126	3,883
	[Firm independence (rc sub)=2,00]	,901	,930	,940	1	,332	2,463	,398	15,242
	[Firm independence (rc sub)=3,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	,059	,680	,008	1	,930	1,061	,280	4,023
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,838	,996	,709	1	,400	,432	,061	3,045
	[Industry=2,00]	,585	1,065	,302	1	,583	1,795	,223	14,471
	[Industry=3,00]	-,152	1,123	,018	1	,892	,859	,095	7,757
	[Industry=4,00]	-,594	1,020	,339	1	,561	,552	,075	4,078
	[Industry=5,00]	,391	,994	,155	1	,694	1,479	,211	10,370
	[Industry=6,00]	-,207	1,004	,042	1	,837	,813	,114	5,817
	[Industry=7,00]	-,325	1,256	,067	1	,796	,722	,062	8,464
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	Process innovation	,230	,108	4,525	1	,033	1,258	1,018	1,554
	Share of personnel in R&D	,135	,034	16,180	1	,000	1,145	1,072	1,222
	Ln firm size	,560	,244	5,248	1	,022	1,750	1,084	2,825
	Firm age [years]	-,014	,010	1,731	1	,188	,986	,966	1,007
	[Firm independence (rc sub)=1,00] * Firm age [years]	,026	,013	3,796	1	,051	1,027	1,000	1,054
	[Firm independence (rc sub)=2,00] * Firm age [years]	-,023	,021	1,204	1	,272	,977	,938	1,018
	[Firm independence (rc sub)=3,00] * Firm age [years]	0[b]	.	.	0	.	.	.	.

a. The reference category is: no innovation.

b. This parameter is set to zero because it is redundant.

Reference category: stand-alone

Parameter Estimates

Product innovation (newness)[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
only NTTF innovation	Intercept	-3,448	1,568	4,835	1	,028			
	[Firm independence (rc standalone)=1,00]	1,421	1,032	1,897	1	,168	4,142	,548	31,313
	[Firm independence (rc standalone)=2,00]	2,006	,833	5,796	1	,016	7,431	1,452	38,037
	[Firm independence (rc standalone)=3,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	,346	,631	,301	1	,583	1,414	,411	4,869
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,373	1,035	,130	1	,719	,689	,091	5,233
	[Industry=2,00]	-,014	1,155	,000	1	,990	,986	,103	9,478
	[Industry=3,00]	-,173	1,198	,021	1	,885	,841	,080	8,801
	[Industry=4,00]	,253	1,043	,059	1	,808	1,288	,167	9,942
	[Industry=5,00]	-,722	1,102	,429	1	,513	,486	,056	4,215
	[Industry=6,00]	-,175	1,069	,027	1	,870	,839	,103	6,823
	[Industry=7,00]	,453	1,313	,119	1	,730	1,572	,120	20,624
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	Process innovation	-,156	,130	1,437	1	,231	,856	,663	1,104
	Share of personnel in R&D	,102	,035	8,316	1	,004	1,107	1,033	1,187
	Ln firm size	,422	,266	2,525	1	,112	1,525	,906	2,566
	Firm age [years]	,015	,009	2,496	1	,114	1,015	,996	1,034
	[Firm independence (rc standalone)=1,00] * Firm age [years]	-,038	,021	3,315	1	,069	,962	,924	1,003
	[Firm independence (rc standalone)=2,00] * Firm age [years]	-,034	,015	5,518	1	,019	,966	,939	,994
	[Firm independence (rc standalone)=3,00] * Firm age [years]	0[b]	.	.	0	.	.	.	.
NTTM innovation	Intercept	-3,734	1,545	5,838	1	,016			
	[Firm independence (rc standalone)=1,00]	1,258	,983	1,635	1	,201	3,517	,512	24,175
	[Firm independence (rc standalone)=2,00]	,356	,874	,166	1	,683	1,428	,258	7,918
	[Firm independence (rc standalone)=3,00]	0[b]	.	.	0	.	.	.	.
	[Multinationality=,00]	,059	,680	,008	1	,930	1,061	,280	4,023
	[Multinationality=1,00]	0[b]	.	.	0	.	.	.	.
	[Industry=1,00]	-,838	,996	,709	1	,400	,432	,061	3,045
	[Industry=2,00]	,585	1,065	,302	1	,583	1,795	,223	14,471
	[Industry=3,00]	-,152	1,123	,018	1	,892	,859	,095	7,757
	[Industry=4,00]	-,594	1,020	,339	1	,561	,552	,075	4,078
	[Industry=5,00]	,391	,994	,155	1	,694	1,479	,211	10,370
	[Industry=6,00]	-,207	1,004	,042	1	,837	,813	,114	5,817
	[Industry=7,00]	-,325	1,256	,067	1	,796	,722	,062	8,464
	[Industry=8,00]	0[b]	.	.	0	.	.	.	.
	Process innovation	,230	,108	4,525	1	,033	1,258	1,018	1,554
	Share of personnel in R&D	,135	,034	16,180	1	,000	1,145	1,072	1,222
	Ln firm size	,560	,244	5,248	1	,022	1,750	1,084	2,825
	Firm age [years]	,012	,009	2,123	1	,145	1,013	,996	1,030
	[Firm independence (rc standalone)=1,00] * Firm age [years]	-,049	,020	5,816	1	,016	,952	,915	,991
	[Firm independence (rc standalone)=2,00] * Firm age [years]	-,026	,013	3,796	1	,051	,974	,949	1,000
	[Firm independence (rc standalone)=3,00] * Firm age [years]	0[b]	.	.	0	.	.	.	.

a. The reference category is: no innovation.

b. This parameter is set to zero because it is redundant.

Appendix E – Interview transcripts

For privacy reasons, the interview transcripts have been sent to the supervisors in separate files.

Appendix F - Research integrity form Master Thesis

Name: Bastiaan Henderik	Student number: S30256254
RU e-mail address: b.henderik@student.ru.nl	Master specialisation: Strategic Management

Thesis title: Firm independence as a driver of technological innovation
Brief description of the study: The aim of the study is to see whether firm independence has an impact on the amount of technological product innovation a firm introduces. Based on existing theory and empirical studies, it is expected that autonomy indeed has an impact on technological product innovations, except when it comes to innovations that are only new to the firm. For those innovations, group membership is thought to be more important than autonomy. The hypotheses are tested using a mixed methods research approach.

It is my responsibility to follow the university's code of academic integrity and any relevant academic or professional guidelines in the conduct of my study. This includes:

- providing original work or proper use of references;
- providing appropriate information to all involved in my study;
- requesting informed consent from participants;
- transparency in the way data is processed and represented;
- ensuring confidentiality in the storage and use of data;

If there is any significant change in the question, design or conduct over the course of the research, I will complete another Research Integrity Form.

Breaches of the code of conduct with respect to academic integrity (as described / referred to in the thesis handbook) should and will be forwarded to the examination board. Acting contrary to the code of conduct can result in declaring the thesis invalid

Student's Signature: _____ Date:

To be signed by supervisor

I have instructed the student about ethical issues related to their specific study. I hereby declare that I will challenge him / her on ethical aspects through their investigation and to act on any violations that I may encounter.

Supervisor's Signature: _____ Date:

Appendix G – Assessment form Master Thesis

Name of student ……

Student ID no. ……. Date of defense …….

CRITERIA	ASSESSMENT (circle your choice)	NOTES
1. Problem formulation	I – S – G - VG	
2. Theoretical background	I – S – G - VG	
3. Methodology (including research ethics)	I – S – G – VG	
4. Analyses	I – S – G – VG	
5. Discussion and conclusions	I – S – G – VG	
6. Practical implications, reflection, and recommendations	I – S – G – VG	
7. Style and structure	I – S – G – VG	
8. Consistency	I – S – G – VG	
9. Process	I – S – G – VG	
10. Defense	I – S – G – VG	

Student handed in a signed Research Integrity Form.	Yes / No
The thesis is checked for plagiarism or fraud.	Yes / No

Motivation for final grade

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Name of supervisor: Tentative grade:

Name 2nd examiner: Tentative grade:

I = insufficient; S = sufficient; G = good; VG = very good final grade