6 Conclusions

6.1 Summary of results
Innovation comes from ideas, which are sometimes the result of years of research. However, ideas are non-rivalrous (Romer, 1990); that is, by using an idea one does not exclude someone else from using the same idea. This non-rivalrous nature of ideas makes it possible for any competitor to copy the idea without having to make the same amount of investments, and this competitor would therefore be able to sell the innovation at a lower price than the original inventor. This phenomenon, generally known as the ‘free-rider problem’ (Olson, 1965), would result in a lack of incentive for any firm or individual to invest in inventive activity, and eventually would lead to a lack of technological progress.

A way to overcome this problem is by creating a temporary monopoly, just long enough for the inventor to reclaim his fixed costs, but also short enough to prevent it from limiting future technological progress. This eventually led to our current intellectual property system that provides innovative firms with the possibility to gain a temporary monopoly on an innovation by applying for a patent, registering a design, registering a trademark, or registering a copyright. However, as the literature suggests, many innovative firms, especially small and medium-sized firms (SMEs), decide not to use one of those registered formal protective actions. Instead, SMEs choose to protect their innovations by other, less formal means, or decide not to protect at all.

In order to gain more insight into how and why firms protect their innovations, this thesis has focused on the following three research questions:

(i) How do firms protect their innovations?
(ii) Which factors determine the choice of a specific form of protective action?
(iii) Is the use of a specific form of registered formal protection related to firm performance?
Chapter 2 presented an analysis of the patent data (obtained from the Netherlands Patent Office) of all of the around 26,000 firms in the north-east of the Netherlands (Zwolle Chamber of Commerce area). On the basis of the patent data, we concluded that, in line with the findings from the literature in the field of innovation and innovation protection, 99.5 per cent of the SMEs in this region did not own patents. We also found that these SMEs owned relatively more 6-year patents than large firms did. This is not surprising, since the (currently abolished) 6-year patent was specifically tailored for SMEs, by being cheaper and more short-term-oriented. Furthermore, the few SMEs in the Zwolle Chamber of Commerce region that owned one or more patents did not let them expire as often as larger firms did. It seems that SMEs that own a patent, maybe due to their high dependence on a single innovation (Nooteboom, 1994), value these patents more than larger firms do.

Chapter 2 also included the results of 20 explorative interviews with owner-managers of SMEs from the same region on their choice of protective actions, and their motives for doing so. Following Kitching and Blackburn (1998), we distinguished four groups of protective actions with an increasing level of formality (see Section 1.2 for details): ‘no protection’; ‘informal protection’ (e.g. maintaining lead-time advantages, investing in a relationship based on trust); ‘non-registered formal protection’ (e.g. confidentiality clauses, licensing); and ‘registered formal protection’ (i.e. patents, registered designs, trademarks, and registered copyrights).

Although our results may be biased by selecting our respondents from the network of Windesheim University of Applied Sciences, on the basis of a limited number of 20 interviews, we confirmed that the respondents prefer the less formal protective actions (i.e. confidentiality clauses, licensing, investing in maintaining lead-time advantages, investing in relationships based on trust) over the more expensive registered formal forms of protection (i.e. patents, registered designs, trademarks, registered copyrights). We also found indications that the degree of formality of the protection is positively related to the age of the firm; to the amount of R&D investments of the firm; and to whether the innovation was a product innovation (as opposed to process, market, or service innovations). Contrary to the literature, we found no indication that the degree of formalisation of the protection was related to the number of employees of the firm or to the educational level of the entrepreneur. However, this lack of statistically significant results for size and educational level
seems to be caused by the low variance in size and the selection of owner-managers from the network of Windesheim University of Applied Sciences.

Although we originally aimed to include more industries (see Section 1.6), due to the low number of respondents from other industries Chapter 3 focused specifically on the protection of innovations by SMEs in the Dutch printing industry. This rather traditional sector is of special interest, because of its large number of SMEs. Furthermore, starting in the 1930s, there have been three main drivers of innovation in the printing industry, which resulted in a sector that seems continuously challenged to reinvent itself. First, the sector has transformed from a blue-collar craftsman industry to a more computerised industry, which has led to increased outputs, and to a decrease in the demand for skilled blue collar workers. Second, owing to the (inevitable) use of ink, chemicals, and other toxics in the sector, a great deal of attention has been paid to health issues among employees and to environmental effects. This has resulted in various governmental regulations and sector-initiated certificates, all aimed to make the sector more sustainable. Third, more recently, the advent of home printing and e-reading has resulted in more changes in the sector. According to Smallbone et al. (2000), the introduction of new technologies and closer ties between customers and printers have fundamentally altered the structure of the industry. This has resulted in new products and services ‘...and the creation of new markets for on-demand, short-run, colour printing, as well as database creation and management’ (Smallbone et al., 2000, p. 299).

We sent a survey to 1,337 firms in this sector with questions about the firm, the owner-manager, and a recent product and/or process innovation. Based on the results of 79 SMEs (out of a total of 93 responses) that had introduced a product innovation, a process innovation, or both, we found large differences in the determinants of the degree of formality of the protection of product and process innovations. Generally, process innovations are protected less formally than product innovations. This outcome of our research is not very surprising, since ‘Process innovations are less subject to public scrutiny and thus can be kept secret more readily’ (Cohen et al., 2000, p. 10). This difference between product and process innovations does not only reflect on the degree of formality of the protection of product and process innovations, but also reflects on the different factors that are related to the degree of formality of the protection.
Looking at the determinants of the degree of formality of protection of product innovations, we found this degree to be positively related to: whether the firm received a form of public financial support for the innovation; whether the firm collaborated (with competitors, customers, suppliers, public knowledge institutions, Chamber of Commerce, or sector association) during the innovation process; the level of innovativeness of the innovation; and whether the firm/entrepreneur had experience with the different protective actions. Surprisingly, we found the degree of formalisation of protection of product innovations to be negatively related to the level of innovation investments of the firm and to the firm being located in an urban area (as opposed to a rural area). The negative effect of the level of innovation investments on the degree of formality of the protection could be caused by many of the innovations in the Dutch printing industry being adopted (e.g. by buying a new printing press) instead of being invented by the firm itself. Adopting an innovation instead of inventing it would make protection useless, and in some cases even impossible, since it would probably already be covered by the inventing firm itself. The negative effect of being located in an urban area on the degree of formality of the protection is also rather surprising at first sight. However, this negative effect might be related to the fact that service-oriented firms (e.g. copy shops) in the Dutch printing industry are more often located in urban areas, while the more innovative mass-production printing houses are more often located in low-populated industrial areas.

The degree of formality of the protection of process innovations was found to be positively related to: whether the firm had received a form of public financial support for the innovation; the newness of the innovation (new to the firm; new to the region; new to the country; new to the world); and the innovativeness of the innovation. Again, similar to product innovations, the degree of formalisation of the protection of process innovation was found to be negatively related to the firm’s level of innovation investments, and to the firm being located in an urban area.

These studies on the protective behaviour of SMEs in the north-east of the Netherlands and the Dutch printing industry from Chapter 2 and 3, combined with the findings from the literature (mostly on the patents of large firms), gave us insight into the variables that are related to the protective behaviour of both SMEs and large firms. We took these explorative results from Chapters 2 and 3 and tested them in Chapter 4, using the much larger data set of the Dutch 2006 Community Innovation
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Survey (CIS), on three different kinds of registered formal protection (i.e. patents, registered designs, and registered copyrights).

Looking at the results of Chapter 4, first of all, we confirmed earlier findings that many of the innovative firms do not apply for a patent, register a design, or register a copyright. Furthermore, we found the application for patents, registration of designs, and registration of copyrights to be related to different firm and innovation variables (since we had no control over the survey questions, we were unable to include any entrepreneurial variables). First, whether the firm applied for a patent was found to be positively related to all included firm and innovation variables: the size of the firm in terms of number of employees; the level of R&D investments of the firm; whether the innovation is a product innovation (and not a process innovation or service innovation); whether the firm operates in a patent-intensive sector; the geographical market scope of the firm; whether the firm collaborated (with competitors, customers, suppliers, public knowledge institutions, Chamber of Commerce, or sector association) during the innovation process; and whether the firm received a form of public financial support for the innovation. Registering a design was only found to be positively related to whether the innovation was a product innovation, and whether the firm collaborated during the innovation process. Finally, registering a copyright was found to be positively related to the level of R&D investments of the firm, and negatively to the firm operating in a patent-intensive sector.

Chapter 5 focused on the relationship between the use of registered formal protection and firm survival, and between registered formal protection and firm growth (measured by changes in the number of employees, the amount of sales, and the level of labour productivity). This was done by comparing innovative firms that decided to apply for a patent, register a design, register a trademark, or register a copyright with innovative firms that did not, using the data from the Dutch 2006 CIS data set combined with employment records and survival records from the Dutch General Business Register (Algemene Bedrijven Register) for the years 2006 up to and including 2009, and sales records from the Dutch Production Statistics (Productie Statistiek) for the years 2006 up to and including 2008. Since both our own results from Chapter 4 and the results from the literature showed large differences in the protective behaviour between sectors, we accounted for heterogeneity between sectors by dividing the group of CIS respondents into four different sectors (supplier-
dominated; scale-intensive; specialised suppliers; science-based), based on a classification by Pavitt (1984) which was extended by Bogliacino and Pianta (2010).

Looking at the results of Chapter 5, first of all, we found the application for patents, registration of designs, and registration of trademarks to be positively related to firm survival in all sectors, except the scale-intensive sector. However, this higher survival rate could be caused by the best innovations and/or the best-performing firms being protected in the most formal manner, and even without any protection, these firms would probably also display a higher survival rate. These kinds of endogeneity problems make it difficult to determine whether the higher survival rate comes from the firm, the innovation, the protection, or a combination of these factors. In the scale-intensive sector we only found application for a patent to be positively related to firm survival. This may be because firms operating in this sector are mainly searching for innovations that reduce production costs, which would make protecting the name or appearance of a product just not that important for them. More striking is that we hardly found any statistically significant relationship between the use of registered formal protection, on the one hand, and firm growth measured by firm employment, sales, and labour productivity, on the other. Possible explanations could be the unpredictable nature of growth rates (Geroski et al., 1997), the increased speed of modern innovation (Florida, 2002), the changing role of protection (Artz et al., 2010); or these results being particular for the Netherlands.

6.2 Conclusions

By combining the results of all the research covered in the empirical chapters of this thesis, we can now answer our three Research questions and discuss our contribution to the existing literature in this field of research.

(i) How do firms protect their innovations?

First, based on Kitching and Blackburn (1998), we have made a distinction between four groups of protective actions with an increasing level of formality: ‘no protection”; ‘informal protection’ (e.g. maintaining lead-time advantages, investing in a relationship based on trust); ‘non-registered formal protection’ (e.g. confidentiality clauses, licensing); and ‘registered formal protection’ (i.e. patents, registered designs, trademarks, and registered copyrights). From Chapters 2, 3 and 4,
we can confirm the findings from the literature that many of the innovative firms in the Netherlands do not apply for a patent, register a design, register a trademark, or register a copyright, but instead protect their innovation in a less formal way, or not at all. Furthermore, firms that decide to apply for a patent, register a design or register a copyright, mainly apply for a patent, and not so often register a design or register a copyright.

Since the majority of the results from the literature come from large firms, and not so much from SMEs (see Sections 1.3 and 1.4), we also explicitly focused on the protective behaviour of Dutch SMEs. First, we found many SMEs in the north-east of the Netherlands (see Chapter 2) do not apply for patents. The few SMEs in the north-east of the Netherlands that owned one or more patents, owned relatively more 6-year patents than larger firms did. This is not surprising, since the 6-year patent was specifically tailored for SMEs, by being cheaper and more short-term oriented. We also found that SMEs in the north-east of the Netherlands that owned a patent (both 6-year and 20-year) did not let them expire as often as larger firms did. Apparently, SMEs that do decide to patent value their patents more than larger firms do.

(ii) Which factors determine the choice of a specific form of protective action?

In Chapter 4 we confirmed the firm and innovation aspects that are generally considered to be related to the application for patents. Whether or not a firm decided to apply for a patent was found to be related to: the size of the firm (in terms of the number of employees); the level of R&D investments by the firm; whether the innovation was a product innovation; whether the firm operates in a patent-intensive sector; the geographical market scope of the firm; whether or not during the innovation process a firm collaborated (with competitors, customers, suppliers, public knowledge institutions, Chamber of Commerce, or sector association); and whether the firm received a form of public financial support.

Although our number of respondents who registered a design without also having applied for a patent was limited in Chapter 4, the decision to register a design was found to be positively related to whether the innovation was a product innovation (and not a process innovation or any other kind of innovation), and whether the firm collaborated with other parties during the innovation process. Surprisingly, we did not
find a statistically significant relationship between the size of the firms, measured in terms of number of employees, and the registering of a design.

Our number of respondents who registered a copyright (without also having applied for a patent or registered a design) presented in Chapter 4 was also limited. However, we did find the registration of copyrights to be positively related to the level of R&D investments of the firm, and negatively related to the firm operating in a patent-intensive sector.

Regarding the factors that are related to the protective behaviour of SMEs, in Chapter 2 we found that a number of the results from the literature on patents and large firms also apply to the degree of formalisation of the protective actions by the SMEs selected from the network of Windesheim University of Applied Sciences. These results concern: the age of the firm; the level of R&D investments by the firm; and whether the innovation was a product innovation. Contrary to the findings from the literature on patents, we did not find the size of the firm in terms of number of employees to be related to the degree of formality of the protection.

In Chapter 3, specifically on the protective behaviour of SMEs in the Dutch printing industry, we found the degree of formality of the protection of both product and process innovations to be positively related to: whether the firm received a form of public financial support; the innovativeness of the innovation; and a rural location; and negatively related to innovation investments.

The protection of product innovations (but not process innovations) by SMEs in the Dutch printing industry was also found to be positively related to collaboration (with competitors, customers, suppliers, public knowledge institutions, Chamber of Commerce, or sector association) during the innovation process, and earlier protective behaviour of the small or medium-sized firm (or the entrepreneur). The protection of process innovations of SMEs in the Dutch printing industry was, contrary to product innovations, also positively related to the newness of the innovation.

(iii) Is the use of a specific form of registered formal protection related to firm performance?

With regard to Research question (iii) we can conclude that, with the exception of the scale-intensive sector, the application for a patent, registration of a design, or
registration of a trademark is positively related to firm survival. In the scale-intensive sector only having applied for a patent is positively related to firm survival.

Furthermore, in contrast to the findings in most of the literature, we hardly found any statistically significant relationship between registered formal protection and the growth of firms measured by firm employment, sales, and labour productivity. This may be caused by: the unpredictable nature of growth rates (Geroski et al., 1997); the increasing speed of innovation (Florida, 2002), and the inability of patenting and other protective systems to match this speed; the fact that, nowadays, patents and other protective actions seem to have mainly a strategic purpose, and may be ‘...only distantly related to a firm’s innovation efforts’ (Artz et al., 2010, p. 736); or these results being particular for the Netherlands.

### 6.3 Implications

Although our results presented in this thesis are subject to the above-mentioned limitations regarding included sectors, country, regions, and selection of respondents, some important implications for at least the Netherlands can be derived concerning the factors that determine the decision to opt for a specific kind of protection and the relationship between registered formal protection and firm performance.

The most important implication of these results comes from the fact that, contrary to the findings from the literature, we hardly found any statistically significant relationship between registered formal protection and firm growth. However, in the few cases we did find a statistically significant relationship between registered formal protection and firm growth, the coefficients were relatively large and in majority positive on the number of employees and negative on sales and labour productivity. Because patents, registered designs, trademarks and registered copyrights are meant to give an inventor a temporary advantage (as an incentive to keep investing in R&D), this general lack of a statistically significant relationship could (after more research) emphasise the need for improvements of the current protective system. On the basis of the work of Florida (2002), one could even hypothesise that owing to the increased speed of innovation (possibly with the exception of a few specific sectors in which the investments are high and innovations are easy to imitate), we might need some kind of short term version of the current protection system more tailored to modern kinds of innovation, or that maybe there is no need for registered formal protection at all.
A second important implication comes from the fact that, although the probability of the application for a patent is related to firm size, this was not confirmed for registered designs. This is rather unexpected, since patents and registered designs have, other than the differences of what they protect (technology vs. shape), many similarities in costs, procedures and degree of protection. Apparently, whatever is holding SMEs back from applying for a patent is not there for registered designs, which could (after more research) be valuable information for initiatives that aim to promote patents among SMEs.

6.4 Further research

Although this dissertation has shed more light on the protective behaviour of firms, it has also raised a number of new questions. First of all, although we found many firm, innovation, and entrepreneurial characteristics that are related to the decision to have a certain kind of protection, or to the degree of formality involved, our results also show many differences between the aspects that are related to the application for patents, the registration of designs, and the registration of copyrights. In particular, the fact that firm size is related to the application for patents, but not to the registration of designs and the registration of copyrights, was unexpected. However, since our data set contained a rather small number of firms that only registered a design or a copyright, more research on this matter would be valuable.

Second, our results from the Dutch printing industry included many results that may be limited to this sector. More specifically, lower firm innovation investments in the Dutch printing industry are related to a more formal way of protecting. Is this specific for the Dutch printing industry, or do these results also emerge in other industries? This would call for more research on both the Dutch printing industry, as well as on other industries.

Third, this dissertation researched the effectiveness of registered formal protective actions. This was done by comparing innovative firms that applied for a patent, registered a design, registered a trademark, or registered a copyright with other innovative firms. This dissertation did not include the effectiveness of the (less formal) non-registered or informal protective actions, and therefore gives no insight into the interesting question which protective actions are the most effective for a specific type of firm and innovation. A more detailed instrument to measure the (combination of) actions used to protect innovations and their effects on firm
performance could be developed, after which more research, similar to that undertaken in Chapter 5, including alternatives for registered formal protective actions, would be of value.

Finally, we found hardly any statistically significant relationship between the use of patents, registered designs, trademarks, or registered copyrights and the growth of firms. However, this could be caused by the relatively unrefined way we measured both the protective actions (by means of a dummy stating whether a firm used a specific kind of protection) and firm growth (by the increase in the number of employees, sales, and labour productivity). Furthermore, these results do not answer the question why these registered formal protective actions do not have a stronger impact on the growth of firms. More research regarding the effect of protective actions in two areas of interest would prove valuable. First, why do our patenting and other intellectual property systems not seem to contribute to firm performance? Second, how could the current intellectual property systems be improved to better serve non-publicly traded firms, specifically SMEs?