

Early-Stage Intellectual Property Strategy: Too small to care?

Abstract: Managers of innovative firms are often required to carefully employ intellectual property (IP) strategies, in order to protect their innovations. Formal IP protection through patents and trademarks is associated with high direct and indirect costs, which is why many small and medium sized enterprises (SMEs) do not rely on the formal IP protection which patents and trademarks offer. Instead, they are used in a number of ways to improve the SME's reputation, to generate cashflows and to attract investors.

This research offers an indepth literature review on the topic of SMEs' patenting and trademarking motivations. Furthermore, an analysis of the relationship between patents and trademarks filed by an SME and the amount of funds raised provides valuable information for SME managers.

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1. Introduction and Concepts

Technological change is one of the key drivers of growth and evolution in modern society. There have been countless inventions in history, which are now considered essential in our everyday lives. It would be hard for instance to accurately picture our society without the discovery of Penicilin in 1928 or the invention of the automobile in the late 19th century. Innovation is however not a random process, which yields groundbreaking results 'by accident'. On the contrary, a major share of innovation today is the result of large sums of money being invested into research and development (R&D) programs. Once an innovation enters a market, it becomes extremely difficult to prevent third parties from also benefiting from the newly developed technology or process. In order to be able to appropriate the returns on a R&D investments, managers of innovative firms are required to carefully employ intellectual property (IP) strategies, making use of tools such as patents and trademarks.¹

With the patenting and trademarking system in place, any firm has - in theory - the legal means to officially protect its intellectual property (IP) from imitation by competitors, as well as to secure the name under which the invention will enter the market. In reality however, the ability to protect one's IP is subject to many more factors, than the willingness to apply for a patent. Firstly, patents are granted on a national level only, such that patenting procedures and costs differ significantly across nations. These differences in procedure, alongside cultural differences and language barriers, make it extremely time and capital consuming to register patents in multiple countries at once. Furthermore, simply acquiring a patent for an invention does not result in instant and complete protection against imitation by competitors. The maintenance and enforcement of property rights is a question of time, financial and human capital, as it requires monitoring both domestic and possibly foreign markets and pursuing legal action in a case of violation.

Looking at these facts, it becomes clear that making use of one's IP rights by means of IP protection is a costly undertaking. This usually does not cause a huge problem for large and internationally established firms, which often have a designated, multi-lingual legal department and the capital to cover litigation costs. It clearly does pose a problem for small and medium sized enterprises (SMEs), who - due to their smallness - lack the necessary resources. In the following, this research paper will focus on SMEs' motives

¹ A patent is - as defined by the „United States Patent and Trademark Office“ (USTPO) - „the grant of a property right to the inventor“. A trademark is defined by USTPO as „a word, phrase, symbol, and/or design that identifies and distinguishes the source of the goods of one party from those of others.“

for protecting their IP, as compared to large companies.

The usefulness of both patents and trademarks has often been discussed in literature - with inconclusive results. Although the majority of innovating firms employ patents in order to protect their IP, their effectiveness in terms of appropriation and protection against imitation by others turns out to be relatively low (Cohen, 2000).

Existing research into the topic of trademarks has stressed their positive effect on firms' performance and has discovered a favorable effect on a firm's market valuation (de Vries, 2013). The registration of trademarks is regarded a cheaper and easier form of IP protection, when compared to the costly process of filing for and maintaining patents (Hahn et al., 2013). Trademarks are therefore especially suited for constrained firms, such as SMEs, who often lack the capital to fight costly lawsuits against patent infringements (Lanjouw and Schankerman, 2004).

The circumstances described above give rise to the following questions, to which the author of this research paper intends to find suitable answers:

- *Why do SMEs file for patents?*
- *For what purpose do SMEs register trademarks?*

While most research on the topic of patenting has been focussed on large enterprises , there has been some research conducted on SMEs' patenting decisions and motivation. One important recent research paper on patent management among entrepreneurial SMEs by Holgersson (2013) offers an indepth examination of SMEs' motives for employing patents. In contrast to research on patents, there has been little research on firms' trademarking decisions and motives and even less with respect to SMEs specifically.

The objective of this paper is to fill this void, by providing and integrated review of existing literature on the concepts of patents and trademarks, as well as examining the motivation of SMEs for filing both patents and trademarks. The second section of the paper will comprise of an extensive review of existing literature on the topic. The aim of this section is to discuss SME's rationales behind the different uses of patents. In section 3, the dataset for the empirical part of this paper will be presented.

The empirical part of this research will be done on the basis of a dataset, which contains information about a large sample of U.S. start-ups across multiple industries. Alongside some general variables, such as the start-ups' age and industry, the dataset contains the

number of funding rounds for each start-up, the amount of funding received during each round and the number of patents and trademarks filed by a start-up. This dataset will allow for an analysis in section 4 of how the number of patents and trademarks filed by SMEs is associated with the likeliness of receiving external funding and the magnitude of the funding received, thereby testing the validity of the hypotheses presented below. More generally speaking, the effectiveness of patents and trademarks in attracting venture capital investors can be studied.

A stream of research on the topic of SMEs has provided insight into the typical characteristics of small ventures. Blomqvist (2002) argued that small businesses in the technology sector are flexible, visionary, non-hierarchical and therefore fast in making decisions and most importantly their resources were mostly „people-embodied“. Further research in the NTBF (new technology-based firm) sector has given rise to the notion that small technology firms are lacking financial capital (Storey and Tether, 1998). Based on these findings and furthermore supported by section 2 of this paper, it will be argued that the accumulation of investment capital constitutes one of the main objectives for SMEs. A focused research on the relationship between patent and trademark applications on the one side and investment capital received will provide valuable IP strategy insights for SME managers who are aiming at attracting new investors and raising new capital.

The research question states: „*How is the number of patents and trademarks filed by an SME associated with the funding received by the SME?*“

In order to answer this research question, two linear regression analyses will be conducted. First, it will be tested how the total number of patents and trademarks filed are related to the total amount of funding received. The first hypothesis states:

1. *The number of patents and trademarks filed is positively associated with an increase of the amount of funding received.*

Next, it will be examined how the number of patents and trademarks held relates to the number of funding rounds reached and more specifically how it affects the likeliness of reaching the next funding round.

2. *The number of patents and trademarks filed is positively associated with an increase of the number of funding rounds reached.*

The fifth and final section will conclude the paper by answering the research question, suggesting directions for future research and examining the policy implications of the findings.

2. Theory

2.1 Patents

As indicated in the introduction, the effectiveness of patents in terms of securing the returns from new products or services is somewhat questionable. On the other hand, Mansfield (1986) showed that even in industries, in which the importance of patents was reported to be low, more than 60% of patentable innovations were patented nonetheless. This circumstance was termed the 'patent paradox' and leads to one of the core questions of this paper: *Why do SMEs file for patents?*

In order to provide an answer to this question and to develop a set of patenting motives, this discussion will employ a two-step approach. First, each motive is derived from existing literature. Second, it will be argued whether this specific motive may or may not be relevant with regards to SMEs.

Motivations to patent have widened in today's business environment and shifted away from their traditional purpose of protection against competitors. While most firms continue to mainly patent to prevent imitation by competitors, licensing and to strengthen the firm's position in negotiations (Arundel et al., 1995), research shows that additional motivations exist, such as to enhance the firm's reputation and value (Cohen et al., 2000; Blind et al., 2006), in order to attract investors (Rassenfosse, 2012). One by one, each of the motives mentioned above will now be examined in close detail.

[Table 1 here]

2.1.1 Protection from imitation

A patent's main function is the „formal“ protection of the patent holder's IP, thereby theoretically securing returns from R&D investments. There are a number of drawbacks to patents, which inhibit their usefulness as means of IP protection: Harabi (1995) has shown that competitors are often able to legally „invent around“ patents, thereby limiting the protective function of patents (Levin et al., 1987). Secondly, filing for patent protection requires the innovator to publicly disclose details concerning the product or process at hand (Duguet and Kabla, 1998), thereby giving the competition access to potentially vital information. Last but not least, registering a patent is tied to a number of direct and indirect costs, which are generally hard to approximate in advance (Cohen, 2000, Kitching and Blackburn, 1998).

In reality the effectiveness of patents in terms of IP protection has been challenged repeatedly. In fact, a stream of studies has confirmed the limited relative usefulness of patents for protecting IP, when compared to other „informal“ means of appropriation (Harabi, 1995; Kitching and Blackburn, 1998; Cohen et al., 2000). Other measures of appropriation such as secrecy, superior marketing efforts and lead time creation are preferred over patenting and do not directly entail a formal protection of IP (Levin et al., 1987; Holgersson, 2013; Kitching and Blackburn, 1998).

Across firms of all sizes, keeping trade secrets, more precisely keeping essential details about a new product or process under lock and excluding competitors from this knowledge, is rated as more valuable than patenting that product or process (Arundel, 2001). Furthermore, firm size is negatively correlated with the likelihood of a firm preferring secrecy over patents (Arundel, 2001). In other words, SMEs are more reliant on secrecy, than large firms. This can be explained by the fact that patents are too costly for SMEs to effectively maintain (Kitching and Blackburn, 1998; Holgersson, 2013).

Superior marketing efforts serve to capture and protect a share of the market by creating customer loyalty. It furthermore helps to protect a firm against rapid imitation, since the creation of a skilled sales team and a loyal customer base is time consuming. The effectiveness of superior marketing effort as a means of appropriation is unanimously rated as strong and in particular stronger than the effectiveness of patents (Harabi, 1995).

Finally, lead time creation is regarded as the most important and effective means of appropriation (Harabi, 1995; Levin et al., 1987). It implies that firms enter a market with enough of a „head start“ before its competitors, to not be threatened by imitation. Continuous improvement of its product through R&D enables the firm to maintain its lead time over its competition.

All three means of appropriation mentioned above are regarded as more effective than patents. Due to the limited effectiveness of patents' protective functions and the extraordinarily high direct and indirect costs, which are linked to filing and holding patents, SMEs are more likely to rely on „informal“ means of protection (Kitching and Blackburn, 1998).

2.1.2 Licensing

Improving the firm's cashflow by licensing out patents innovations is generally not a strong motive for patenting activity. Only about 6% of patented innovations is then licensed out (Giuri et al., 2007). There is however evidence that SMEs are more likely to license out their patents, than large firms (Granstrand, 1988; Rassenfosse, 2012). Due

to their structural deficiencies SMEs are often not capable of commercializing their innovations; licensing their patented innovations seems to provide a way for small firms to generate cashflows.

2.1.3 Negotiations

Anrundel (1995) showed that firms often utilize their patents to strengthen their position in negotiations. Since small and resource-scarce SMEs generally lack negotiation power, it is safe to assume that this constitutes a viable motive for patenting. Indeed, in a research on Swiss SMEs, Keupp et al. (2009) have shown that nearly half (44.1%) of the sample named the strengthening of the SMEs position in negotiations as a motive for patenting.

2.1.4 Reputation and Financing

Cohen et al. (2000) showed that firms are able to use their patented innovations to improve the firm's reputation and company value. Given the lack of financial capital, SMEs arguably are especially interested in raising their company value in order to attract new investors. The importance of reputation motives is rated higher among SMEs, relative to large firms (Rassenfosse, 2012).

Table 1 in the appendix summarizes the motives for SMEs patenting activities.

2.2 Trademarks

Similar to the discussion of patents above, a two-step approach will be employed in order to develop a set of trademarking motives. First, each motive is derived from existing literature. Second, it will be argued whether this specific motive may or may not be relevant with regards to SMEs.

Hahn et al. (2013) developed a general framework of small firms' motives for trademarking. Altogether, four distinct motives have been derived: first, the motive of brand equity building; second, the appropriation of rents from investments in innovation; third, the utility of trademarks as quality signals to investors; and last but not least, the income created by licensing inventions to other firms. Each of the four aspects will now be elaborated upon in turn.

[Table 2 here]

2.2.1 Brand equity

The first motive relates to the concept of brand equity. Generally speaking, building brand equity relates to the process of achieving superior customer responses, thereby establishing customer loyalty. A more precise definition of brand equity by Keller (1993) states that brand equity is „the differential effect that brand knowledge has on consumer response to the marketing of that brand“. Keller further argues that brand equity consists of two dimensions: brand awareness (the extent to which consumers recognize a brand's name, logo or symbol) and brand associations (a unique product color, product packaging or product quality, a consumer associates with a brand). Along this line of reasoning, brand awareness is a necessary precondition for brand associations. Krasnikov et al. (2009) argue that trademarks can be classified into two categories, parallel to Keller's two dimensions of brand equity. *Brand-identification trademarks*, such as names, logos or symbols, establish or increase the consumers' awareness of the brand. *Brand-association trademarks*, signifying for example unique product attributes or product quality, encompass the different attribute and non-attribute associations that consumers attach to a brand. The role of trademarks in brand equity building is of high relevance for firms that rely on differentiation of their goods or services to position themselves in the marketplace (Mendonça, 2004), as well as firms which cater to niche markets. With regards to SMEs, they are expected to be highly reliant on differentiation, since they are usually too small to benefit from economies of

scale and thereby pursue cost-leadership. Furthermore, Carter et al. (1994) found that SMEs often target niche-markets (Hoffmann et al., 1998), where brand equity plays a role of paramount importance.

2.2.2 Rents from marketing investments

The second motive for SMEs to file for trademarks is related to the appropriation of rents from the firm's marketing investments (Mendonca, 2004) and the resulting marketing assets. Srinivasan et al. (2008) describe trademarks as „transferable intangible assets, providing [IP] protection for the firm's marketing investments“. Indeed, this notion that trademarks serve to protect brands and their marketing assets is recurring throughout literature on the topic of trademarks (Sander and Block, 2011). In effect, a trademark grants the owner „the exclusive right to use it to identify goods or services, or to license its use to another entity in return for payment“ (Mendonca, 2004). Finally, also in this context, a firm may attempt to use the signalling power of trademarks and decide to file for trademarks in order to „transmit information about [...] its willingness to protect its marketing assets“ (Sander and Block, 2011).

2.2.3 Signals to investors

The third motive of importance for trademarking, as proposed by Hahn et al. (2013), is the usefulness of trademarks as quality signals to investors. The manner in which a firm's trademarks are utilized and managed The question, whether trademarks may serve as a valid indicator for a firm's innovativeness, has been discussed in a number of research papers. As has been discussed above, trademarks convey consistent product quality information to consumers making it easier for consumers to find a suitable product, thereby reducing the consumers' cost of searching for the product. A reduction of consumers' search cost enables a firm to charge a premium on the product, in turn leading to an increase in the firm's profits. A rational firm would increase its investments in innovation in order to maximize this increase in profits (Greenhalgh and Rogers, 2006). This suggests that a firm's trademarking activity constitutes a viable indicator of the firm's innovative activity (Mendonca, 2004). In a different paper, it is stated that „trademark statistics carries information about product development activities prior to [the trademark's] registration“ (Malmberg, 2005). The study furthermore suggests that the validity of trademarks as an indicator of innovation is strongest in industries which make frequent use of trademarks and produce in consumer- and end-user-goods. In line with this rationale, if increased innovation

activity serves as a favorable brand quality signal to investors, then shouldn't a firm with a high amount of trademarks filed should be valued higher, than a firm with little or no trademarks filed? Indeed, empirical research presents consistent proof that the size of a firm's trademarks portfolio is positively related with the firm's investor valuations. (Greenhalgh and Rogers, 2006; Krashnikov, 2009; Sander and Block , 2011; de Vries, 2012). As was discussed above, SMEs are typically interested in the acquisition of resources, namely investment capital, and are therefore likely to make use of trademarks to attract new investors.

2.2.4 Licensing

The fourth and final motive relates to the licensing of trademarks to other firms. In many cases, SMEs lack the capabilities and resources to profitably market and commercialize their innovations by themselves. Often it makes sense for these firms to license out their innovations to other, larger firms in order to generate profits through licensing fees (Thomä and Bizer, 2013). Another reason why SMEs may decide to license their innovations, is the limited regional scope of such small firms. Marketing a product or service across regional borders and in multiple nations is a costly and complicated undertaking, not suitable for SMEs. Last but not least, trademarking is an essential prerequisite for the franchising business model, which is often used by resource-scarce firms (Combs and Ketchen, 1999).

Table 2 in the appendix summarizes the motives for SMEs trademarking activities.

3. Data

3.1 Data overview

The dataset was created from a range of sources, allowing us to reconcile VC investment data and startup IP portfolio data. Investment data of VC funded startups was gathered from the VentureXpert database² (see also Dimov and Milanov, 2010; De Vries, 2012). Information on filed patents and trademarks was obtained through the US Patent and Trademark Office (USTPO) and the EPO Worldwide Patent Statistical Database (PATSTAT).

² VentureXpert database: officially endorsed by the National Venture Capital Association (NVCA) accessed on October 28, 2011. Now available under the name Thomson One Banker (www.ThomsonOne.com)

3.1.1 Investment data

From Venture Xperts, data on 40.055 funding rounds of US-based startups over the period of 1998-2007 was extracted. Funding rounds after 2007 were omitted from the data, since full patent and trademark data could only be gathered until 2007. The dataset was then inspected for missing and invalid values. Observations with missing or invalid values for start-up age, number of patents and trademarks filed, number of funding rounds and amount of funding received were excluded from the dataset. The mean amount of funding rounds reached by US-based start-ups is 2,2 with a maximum of 21 rounds. The average amount of funding received by US-based start-ups is 13,11 million US dollars. For further descriptive statistics please refer to table 3.

Variables	Mean	S.D.	Min	Max	Skewness
Funding received	13,11	18,21	0,02	290,52	4,985
Round number	2,2	1,61	1	21	2,474
Trademark applications (before round)	4,29	35,77	0	1944	50,839
Patent applications (before round)	4,38	26,39	0	1349	42,433
Start-up age (years)	2,67	3,4	0	76,73	7,424

Table 3: Descriptives

NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.

Table 4 summarizes the frequencies of start-ups reaching each funding round. It is clearly visible that nearly half of the observations were initial (first) funding rounds. Only about half of the firms, which have reached the initial funding round, also reach the second funding round. The rate at which the start-ups in the sample progress through funding rounds appears to be stable at near 50%.

Number of funding rounds	1	2	3	4	5	6	7-9	10+	N
Frequencies	1432	764	469	223	126	72	67	9	3162
% (ofN)	45,29%	24,16%	14,83%	7,05%	3,98%	2,28%	2,12%	0,28%	X

Table 4: Frequency table funding rounds

NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.

3.1.2 Patent and trademark data

Patent and trademark portfolios were compiled for the sample of US-based start-ups, which was extracted from the VentureXpert database. The mean number of patent applications among US-based start-ups is 4,38, while the average number of trademark applications is 4,29 (see table 3). From the start-ups in the sample, 42,6% filed at least one patent until 2007, whereas 61,5% had registered at least one trademark. Before the first funding round, that is before having received any capital by external investors, one quarter (25,3%) of the start-ups in the sample had filed at least one patent and nearly four out of ten (39,4%) had registered at least one trademark. Interestingly, it turns out that the share of start-ups holding formal IP protection increases with the number of funding rounds received (see table 5).

Observations which fell into the 99th percentile were eliminated from the dataset, to avoid extreme outliers. The final sample comprised of 3162 funding rounds including 1450 start-ups.

3.2 Variables

3.2.1 Dependent variable

The dependent variable in this regression analysis is *funding received* as given by the VentureXpert database. This variable constitutes the amount of funding (\$US in millions) received by a start-up at the time at which the funding occurred.

3.2.2 Independent variables

The two key independent variables in this regression analysis are the number of *patent applications* and *trademark applications*. Both variables were created by measuring the number of patents and trademarks filed by a start-up up inbetween funding rounds. The first funding round of each start-up constitutes a special case, where all patents and trademarks filed up until the funding round were counted. Patents and trademarks filed after the start-up's last funding round were not included in the dataset. The following control variables were included in the regression analysis. The variable *round number* depicts the number of subsequent funding rounds reached by a start-up. This variable was included, since it can be expected that *round number* is positively related with *funding received*. Small ventures are often initially funded with small amounts of seed capital, followed by larger amounts in subsequent funding rounds. Including round number will allow the author to isolate the effect that patents and

trademarks have on to of the common increase in funding at later rounds. *Start-up age* relates to the age of a start-up, measured in years.

3.3 The model

In the first model, the amount of funding received by the start-up at the next funding round was regressed on the number of patents and trademarks filed by start-ups . This was done in order to test hypothesis 1. The linear regression analysis was first performed, including only the two key independent variables *patent applications* and *trademark applications*. The two control variables were then introduced in a step-wise manner, such that the second model included *start-up age* next to the two key variables. The last model included *patent applications*, *trademark applications*, *start-up age* and *round number*. The regressions were then performed as described above specifically for each of the 16 industries.

The second model was aimed at testing hypothesis 2. The number of funding rounds reached by the start-up was regressed on the number of patents and trademarks filed by a start-up. At first, only the two key independent variables were included in the regression analysis. In a next step, the control variable *start-up age* was added to the model. The last regression of this model included *patent applications*, *trademark applications* and *start-up age*.

4. Results

Table 5 summarizes the results from model 1. *Patent applications* turns out to be positively related with *funding received*, as it shows a significant³ beta coefficient of 0,144. Similarly, *trademark applications* is positively and significantly is related with *funding received* (0,188). The model's goodness of fit (R²) is comparably low at 2,1%.

Adding start-up age into the model results in an amplification of both *patent applications'* and *trademark applications'* effect on *funding received* (0,148 and 0,191 respectively). *Start-up age* had no statistically significant effect on *funding received*.

Including both control variables into the model changed the picture somewhat, as the effect of *patent applications* on *funding received* was decreased by more than half (0,064) and the effect of *trademark applications* also experienced a decrease (0,131). Start-up age now shows a strong and significant negative effect on *funding received* (-0,349). *Round number* shows a strong and positive effect on *funding received* (2,216).

³ Results are taken at a 5% significance level

All coefficients were significant at a 5% level. The model's goodness of fit increased to 5,1%.

The outcome can be interpreted as follows. Filing one extra patent is associated with an increase of 64.000 US\$ in funding received. Holding one extra trademark is associated with an increase of 131.000 US \$ in funding received. Reaching one more funding round is associated with an increase of 2.216.000 US\$ in funding received, which was to be expected as described in section 3.2.2. Given these findings, hypothesis 1 was not rejected.

Variables	1	2	3
Patent applications	0,144** (0,029)	0,148** (0,03)	0,064* (0,03)
Trademark applications	0,188** (0,035)	0,191** (0,035)	0,131** (0,035)
Start-up age	-	- 0,069 (0,097)	- 0,349** (0,099)
Round number	-	-	2,216** (0,221)
R ²	0,021	0,021	0,051

Table 5: Simple Linear Regression Output (Hypothesis 1) Dependent Variable: *funding received*

NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.

* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

In table 6, the results from model 2 are summarized. *Patent applications* shows a small but positive effect on *round number* (0,044). Likewise, the number of *trademark applications* affects *round number* positively (0,032). The model's goodness of fit is 2,1%. When including *start-up age* into the model, the coefficients for *patent applications* and *trademark applications* decrease by a relatively small amount (0,038 and 0,027 respectively). *Start-up age* itself shows a larger positive effect on *round number*, than both key independent variables (0,126). All coefficients were significant on a 1% level. The model's goodness of fit did not change with the introduction of *start-up age*.

The outcome can be interpreted as follows. Holding one extra patent is associated with 0,044 extra funding rounds. Holding one extra trademark is associated with 0,032 extra funding rounds. One extra year in the age of the start-up is associated with 0,126 extra funding rounds. Given these findings, hypothesis 2 was not rejected.

Variables	1	2
Patent applications	0,044** (0,002)	0,038** (0,002)
Trademark applications	0,032** (0,003)	0,027** (0,003)
Start-up age	-	0,126** (0,008)
R2	0,021	0,021

Table 6: Simple Linear Regression Output (Hypothesis 2)

NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); patent data (European Patent Office). Sample includes years 1998-2007.

* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

Table 7 provides an overview of the correlations in this model. The strongest significant correlation was found between *patent applications* and *trademark applications* (0,898). This indicates that in the present analysis a large part of the effect of *patent applications* may be captured by the effect of *trademark applications* and vice versa. With a correlation of such magnitude, it will be virtually impossible to tell the two effect apart. For that reason, the regression analysis was performed two more times, including each of the key independent variables individually. The results are summarized in tables 8.1 and 8.2. The individual coefficients for both *patent applications* and *trademark applications* in tables 8.1 and 8.2 are very close to the coefficients of the original regression analysis in table 5. Therefore we will treat the results in table 5 as valid for the purpose of this analysis. Furthermore a significant correlation of modest magnitude between *start-up age* and *round number* may be explained by the endogenous relationship of funding rounds and time passed, i.e. start-up age increased.

[Table 7 here]

[Table 8.1 and 8.2 here]

The industry specific effects of both *patent applications* and *trademark applications* are summarized in tables 9.1 and 9.2. Regretably, only a few of the effects turned out to be statistically significant. As most of the coefficients remain positive, the general picture remains unchanged however. Both an increase in *patent applications and trademark applications* are associated with increased *funding received*.

[Table 9.1 and 9.2 here]

4.1 Limitations

This research is subject to a number of limitations, which will now be elaborated upon. The wide array of research papers, which were cited in this paper, was handpicked and collected to the best of the authors knowledge. Most of the reasonings in section 2 of this paper are based on empirical literature on the topic of IP strategy and SMEs. Some connections however were made without having empirical evidence at hand; in these cases the author relied on rational reasoning.

The analysis which was performed in sections 3 and 4 was intended to be a first step into the research of IP strategies and their uses for small businesses. The model was therefore kept fairly simple, including only 2 control variables. This resulted in a relatively low predictive power of the two models. This is however not unusual for models in socio-economic research.

Finally, the extremely high correlation between the number of patents filed and the number of trademarks files has a distortive effect on the results of this analysis. Therefore, with this data and approach, one can only make a statement about the joint effect of both patents and trademarks.

6. Discussion and conclusion

The results, which were presented above can be summarized as follows. The discussion of existing literature has provided valuable insights into the motives for SMEs' patenting and trademarking decisions.

It was established that patents offer IP protection of limited effectiveness. Due to the relatively high direct and indirect costs attached to patents, other informal means of protection are preferred among SMEs. It was shown in this research that, despite the limited effectiveness of patents, more than 40% of start-ups in the sample held at least one patent. Alternative motivations for patenting were derived from existing literature. Firms may choose to benefit from their patents by licensing them to third parties, to strengthen their position in negotiations and to improve the firm's reputation, thereby possibly attracting new investors.

Trademarks are known to be less costly to register and maintain, as compared to patents. Although they serve a fundamentally different purpose, it was established that often trademarks are used for similar purposes as patents. Existing literature on the

topic of trademarks gave rise to the following trademarking motives. Firms may register trademarks in order to improve the firm's brandequity, to generate rents from marketing investments, to license them out to others in return for license fees and last but not least, to attract investors.

In this paper it was argued that many SMEs' main objective is the accumulation of investment capital. Therefore, the focus of the empirical part of this research was put on the relationship between the number of patents and trademarks filed and funding received. The analysis showed that both patents and trademarks have a positive effect on the amount of funding received as well as on the number of funding rounds reached. This supports the findings of a number of research papers in the direction of SME IP strategy. De Vries (2012) showed that start-up valuation was positively related with the amounts of trademark application. Rassenfosse (2012) discovered that SMEs commonly patent for monetary reasons, i.e. In order to attract new investors. Holgersson (2013) argued that patents even constitute a prerequisite for VC investments. This paper adds to the stream of research that investment capital received increases with the number of both patent and trademark applications.

For further research the author recommends the use of a more extensive dataset, including more control variables, in order to examine the topic by means of a more elaborate model. It would be especially interesting to extend the research on industry specific effectiveness of means of IP protection.

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Appendix

Protection from imitation	Licensing	Negotiations	Reputation/ Financing
- „Formal“ IP protection very costly to establish and to maintain. - Due to small size and lack of capital SMEs rely on other means of protection	- SMEs may license out innovations, if they lack the capability to commercialize - A way to generate cashflows for budget-constrained firms	- SMEs dont have much leverage in negotiations - SMEs rely on favorable negotiation outcomes	- SMEs aim to accumulate capital from investors - Patents are a viable quality signal for investors

Table 1: Applicability of patenting motives for SMEs

Brand equity	Rents from marketing investments	Signal to investors/ Financing	Licensing
- Brand equity is important for successful differentiation strategies - SMEs often rely on differentiation and niche markets	- SMEs are dependant on successful marketing campaigns	- SMEs aim to accumulate capital from investors - Trademarks serve as a quality signal to investors	- Due to lacking capital, SMEs don't have the capability to expand over wide distances - Franchising requires trademarking

Table 2: Applicability of trademarking motives for SMEs

Variables	Mean	S.D.	Min	Max	Skewness
Funding received	13,11	18,21	0,02	290,52	4,985
Round number	2,2	1,61	1	21	2,474
Trademark applications (before round)	4,29	35,77	0	1944	50,839
Patent applications (before round)	4,38	26,39	0	1349	42,433
Start-up age (years)	2,67	3,4	0	76,73	7,424

Table 3: Descriptives

NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.

Number of funding rounds	1	2	3	4	5	6	7-9	10+	N
Frequencies	1432	764	469	223	126	72	67	9	3162
% (of N)	45,29%	24,16%	14,83%	7,05%	3,98%	2,28%	2,12%	0,28%	X

Table 4: Frequency table funding rounds

NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.

Variables	1	2	3
Patent applications	0,144** (0,029)	0,148** (0,03)	0,064* (0,03)
Trademark applications	0,188** (0,035)	0,191** (0,035)	0,131** (0,035)
Start-up age	-	- 0,069 (0,097)	- 0,349** (0,099)
Round number	-	-	2,216** (0,221)
R ²	0,021	0,021	0,051

Table 5: Simple Linear Regression Output (Hypothesis 1) Dependent Variable: *funding received*
NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

Variables	1	2
Patent applications	0,044** (0,002)	0,038** (0,002)
Trademark applications	0,032** (0,003)	0,027** (0,003)
Start-up age	-	0,126** (0,008)
R ²	0,021	0,021

Table 6: Simple Linear Regression Output (Hypothesis 2)
NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

	Funding received	Patent applications	Trademark applications	Start-up age	Round number
Funding received	1				
Patent applications	0,109*	1			
Trademark applications	0,116*	0,898*	1		
Start-up age	0,019	0,186*	0,157*	1	
Round number	0,205*	0,345*	0,254*	0,339*	1

Table 7: Pearson Correlation Coefficients
NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $p \leq 0.01$.

Variables	1	2	3
Patent applications	0,178** (0,029)	0,178** (0,029)	0,079* (0,03)
Start-up age	-	- 0,005 (0,096)	- 0,324** (0,099)
Round number	-	-	2,358** (0,2191)
R ²	0,012	0,012	0,047

Table 8.1: Simple Linear Regression Output (patents only) Dependent Variable: *funding received*
NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

Variables	1	2	3
Trademark applications	0,224** (0,034)	0,223** (0,034)	0,141** (0,035)
Start-up age	-	0,007 (0,096)	- 0,334** (0,099)
Round number	-	-	2,344** (0,213)
R ²	0,013	0,013	0,050

Table 8.2: Simple Linear Regression Output (trademarks only) Dependent Variable: *funding received*
NOTES: N = 3162 funding rounds of 1450 start-ups. Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); worldwide patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

	Software	Consumer Products and Services	Financial Services	IT Services	Network-ing and Equipment	Medical Devices and Equipment	Computers and Peripherals	Media and Entertainment
Patent applications	0,012 (0,081)	14,688 (10,423)	3,587** (1,001)	-0,016 (0,706)	-0,113 (0,104)	0,2** (0,047)	-0,013 (0,355)	1,068** (0,21)
Trademark applications	0,458** (0,085)	1,502* (0,632)	0,062 (0,34)	0,356* (0,157)	0,726** (0,265)	0,248 (0,145)	0,086 (0,357)	-0,005 (0,052)
N	789	86	81	232	308	233	68	218

Table 9.1: Industry specific regression coefficients
Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.

	Retailing/ Distribution	Telecom-munications	Semicon-ductors	Healthcare Services	Business Products and Services	Bio-technology	Industrial/ Energy	Electronics/ Instrumentation
Patent applications	2,625** (1,021)	0,005 (0,32)	0,17 (0,099)	0,036 (2,402)	0,692 (0,381)	0,085* (0,041)	-2,898 (2,036)	5,152 (0,0)
Trademark applications	1,2* (0,38)	-0,224 (0,308)	0,205 (0,377)	-0,949 (0,028)	0,098 (0,223)	-0,112 (0,173)	1,311 (2,432)	44,888 (0,0)
N	75	361	130	63	126	344	43	4

Table 9.2: Industry specific regression coefficients
Data Sources: VentureXpert (accessed October 28, 2011); trademark data (USPTO); patent data (European Patent Office). Sample includes years 1998-2007.
* Significance level $0.05 > p \geq 0.01$. ** Significance level $p \leq 0.01$.