# Trademarks and the Patent Premium Value: Evidence from Medical and Cosmetic Products

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**Abstract:**

The determinants of the premium value of patents for medical and cosmetic products are analyzed with respect to a complementary IP strategy such as trademarks. I discuss a novel method and database to gauge combinations of patent and trademark pairs regarding the same innovative project. The premium value is computed through a model of renewal decisions for the patent cohorts 1985-1990 that has been designated in the U.K. and Germany. After taking into the account several firm characteristics and patent indicators typically used in the literature, I find ample evidences that patent and trademark pairs are featured by higher valuations.

**Keywords:** patent and trademark pairs, signaling, premium value of patents, renewal decisions, medical and cosmetic products

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## 1. Introduction

Much of literature on patent valuation has attempted to devise indicators that can proxy the intrinsic value of an underlying technological invention (Nagaoka et al. 2010). However, as Teece (1986) argued the value the innovator can extract from a patent depends in significant extent also on the appropriability conditions and complementary assets required for the commercial translation of that invention. More in general, the innovator can put in place strategies in order to ameliorate the conditions that directly affect the value of an invention (Gans and Stern, 2003). With the exception of few works the role that the innovator's strategic behavior plays in determining the value of patents has been overlooked by previous literature (Gambardella and McGahan, 2010). This paper aims to build on this gap and analyzes how trademark strategies affect patent valuation.

The proposed analytical framework carries over research on entrepreneurial finance that has stressed the role of intellectual property as quality signals (Hall and Harhoff, 2012; Gambardella 2013). Similarly to Block et al. (2014) I argue that trademarks by enhancing the signaling function of patents and expanding their breadth of protection increase the value of the patented R&D. In this context I introduce a novel concept namely patent and trademark pair, when the output of the invention process is protected by a combined IP strategy represented by patenting and also filing a trademark. I argue that patent and trademark pairs have a significant signaling value and hence they are featured by higher valuations. I corroborate this view by assessing the premium value of patents for medical and cosmetic products using an ad-hoc dataset on renewal decisions. I opted to limit the analysis solely to medical and cosmetic products because of the importance hold by patent and trademark strategies in the pharmaceutical industry.

In advancing this task I develop a new method and database integrating several sources: bibliographic information from patent and trademark records, patent renewal and opposition decisions, demographic information on the patenting firm, and others. The context is constituted by the universe of the European firms who have filed at least one European Patent Convention (EPC) application for medical and cosmetic products from 1985 to 1990. The new method for defining patent and trademark pairs is given by a string matching algorithm which integrates the bibliographic information on two levels. First, it considers the patenting firm when I have drawn from a database previously developed by Thoma et al. (2010), that provides a direct link of the business companies with their patent and trademark portfolios. A subsequent layer of integration of the pairs is based on the analysis of the textual description of the legal documents. Because patents and trademarks are very rich information sources regarding the technological and commercial activities of a firm, their combination allows to uniquely assess to what extent the patent portfolio of a company has been actively translated in commercial activities and to measure its economic potential.

The ad-hoc dataset on patent valuation is made up of annual renewal decisions and archival information on historical fee costs for patent designations in the U.K. and Germany, whose renewal decisions have been observed from 1985 to 2010. By adopting the approach of Schankerman (1998) and Grönqvist (2008) I compute dollar estimates on the premium value of patent protection in terms of purchasing power parity (PPP). This dataset allows to assess the valuation of patent and trademark strategies and to analyze the determinants of patent value when several IP strategies are jointly combined. In the multivariate regression analysis I take into the account several firm demographic characteristics which correlate with the value of patents such as firm's size and experience, country of origin, growth of R&D investment, primary business activity, listing in financial markets, and others.

I find that the patent and trademark pair strategy affect the premium value of patents even after having controlled for opposition decisions and other patent value indicators typically used in the literature. One patent and trademark pair for medical and cosmetic products is worth on average about US PPP $ 771 thousand and $ 124 thousand for patents designating Germany and the U.K. respectively. The most conservative estimate of the value impact of the pairing strategy is about PPP $ 11 thousand regardless of the designation decision.

## 2. Theoretical framework

Recent literature has analyzed firm performance with respect to the combination of IP strategies of patents and trademarks, positing the hypothesis that trademarks are a proxy of the marketing and commercialization ability of a firm. Helmers and Rogers (2010) show that the trademark stock yields two percentage point higher impact on firm survival as compared to patents. Buddelmeyer et al. (2010) claim that trademarks are positively associated with survival both over the short term and the long run, while patent stocks positively affect survival only in the latter case. Helmers and Rogers (2011) find that trademarks impact also the asset growth after having controlled for several demographic and market characteristics of the firm, whereas a positive impact of patenting on growth is traced solely in the manufacturing and R&D intensive sectors, and when the most valuable filing strategies are taken into account - such as patents having international breadth.

A full-fledged sectoral investigation of the impact of patenting and trademark strategies is constituted by Greenlagh and Rogers (2006), who claim that technological trajectories given by the so-called Pavitt's taxonomy can disentangle the differential impact of the two IP strategies on firm market value. Greenlagh and Rogers focus on the population of UK listed firms that have reported R&D investments in their accounts during 1989-2002, and they elaborate a Tobin's Q ratio approach to measuring the market valuation of a firm. With the exception of the software industry and other high value added services, the trademark stock contributes positively and significantly to the Tobin's Q beyond the investment in R&D and intangibles, whereas patents contribute to market value solely for specialized suppliers and science based industries.

Sander and Block (2006) extend the Tobin's Q analysis by considering a panel made up by the top one thousand largest firms at the worldwide level over the period 1996-2002. This study is among the first attempts in considering indirect indicators for the valuation of trademarks in the same fashion of those used for patents, such as the breadth of protection and opposition decisions. They find that the size of trademark portfolio contributes significantly to market value, after having controlled for the effect of patenting and size of operative activities. Furthermore, the trademark indicators have a significant impact although some caveats are in order with respect to patenting: the Tobin's Q is correlated with the number of opposition actions undertaken by the focal firm but not those received and with only one dimension of the trademark breadth given by the number of jurisdictions where the protection is sought.

Korkeamäki and Takalo (2013) analyze how patents and trademarks of the Apple's iPhone product platform affect the market capitalization of the firm and that of its network of suppliers, service providers, and competitors. Their approach consists in an event study using daily data on stock market value and some key events such as the publication of patent applications, granting decisions, and filing of trademarks. They find that the iPhone related capabilities and resources account for about 15% of the total Apple's market capitalization, and patents and trademarks constitute about one fourth of the overall iPhone's market value. There is also a positive effect on the market capitalization of the Apple's suppliers, but not on that of its competitors and service providers.

The combination of patent and trademark strategies have been analyzed also in the context of the pre-money valuation by venture capitalists (VCs). Block et al. (2014) argue that trademarks can constitute a quality signal between the inventor and the potential financier in order to reduce information asymmetries. To corroborate this hypothesis they analyze the US venture backed start-ups from 1998 to 2007, which have obtained at least one financial round at the seed or early investment stage. They confirm that the combination of patents and trademarks affect the pre-money valuation of startups, although they argue that the signaling intensity decreases with the size of the trademark portfolio and in the latter rounds of financing, when the financier could assess the growth potential of a start-up also with other mechanisms.

These results are line with the entrepreneurial finance literature which has claimed that the value of patents goes beyond the mere protection of the intellectual property (Gambardella, 2013; Hall and Harhoff, 2012). It has been argued that venture capitalists assess the quality of start-ups with the mean of their patent portfolios (Häussler et al. 2014; Hsu and Ziedonis, 2013). Patenting attract financing from prominent VCs who can contribute with a larger share of non financial capital (Hsu and Ziedonis, 2013), though patents are valuable signals for new investors but not old ones (Conti et al. 2013 B), only patents held by the inventor prior to first round of financing have the largest signaling value (Hoenen et al. 2014), and the intensity of the signal decreases with the size of the patent portfolio (Mann and Sager, 2007). Furthermore, Cockburn and Macgarvie (2009) have claimed that patents increase the external financing during an IPO or acquisition, although they are not valuable signals for private investors (Conti et al. 2013 B) and other entrepreneurial financiers except VCs (Conti et al. 2013 A).

Nevertheless the entrepreneurial finance literature has been seldom debated how the company valuation is affected when patent and trademark strategies are jointly combined by the same firm (Block et al. 2014). An additional gap in the literature is constituted by the fact that the unit of analysis is the firm level, and the potential reinforcing effect of other IP strategies on the valuation of a single patent can be inferred only indirectly. In other words previous literature has not analyzed how marketing and commercialization activity directly linked with a patented invention affect its valuation. There is scarce evidence on the determinants of patent value when trademark strategies are combined regarding the same innovative project although complemental investments in marketing and commercialization are essential to yielding economic success and value to an invention (Teece 1986; Chesbrough 2003; McGahan and Silverman, 2006).

Because trademark strategies have the typical goal to build brand awareness and publicity among consumers (Krasnikov et al. 2009), the commercial potential of a patented invention is enhanced in several ways when it is paired with a trademark filing. Trademark strategies anticipate the commercial translation of a technology when it requires novel complementary assets with respect to the incumbent business model (Teece, 1986; Gans and Stern, 2003). More in general, an IP strategy which is articulated as patent and trademark pair (hereafter PTP) signals to customers and competitors in an industry about the market success of an invention project, and therefore it is associated with higher economic return and valuation of the underlying invention. Secondly, patent strategies which are combined with trademarks facilitate communication across technological producers and consumers by establishing a trust relationship (Rujas 1999) and reducing uncertainty about product performance (Bao et al. 2008), which in turn directly affects the financial return the innovator obtains by the patent. A PTP strategy can be used to signal product quality not only in the sale and distribution phase but also in advertisement and publicity activities. In fact, brand names play a critical role for the commercial success of a new product lunch, because consumers use preconceived beliefs with respect to what categories of brand names could be associated to specific product types (Kohli and LaBahn, 1997). In this direction, by increasing the information available to consumers about product categories trademarks facilitate the integration of the invention phase with commercialization (Bao et al. 2008).

Lastly, from a legal point of view trademarks perpetuate the commercial success of a patented product beyond the statutory limit of the patent right if the consumers still perceive a differential value of the branded product after patent expiration. Indeed, the validity of trademarks can be prolonged without an end, although the owner has to demonstrate that the mark is continuously used in commercial activities. Managing intellectual property rights both during filing, renewals and legal disputes has relevant costs, but the innovator can scale up the investment by combining several strategies together. Trademarks increase the bargaining power of the innovator for technology licensing and trading (Graham, Marco and Meyers, 2014). In conclusion, trademarks easy the knowledge transfer even in the non business sector by improving the innovator's reputation (Squicciarini, Millot, Dernis, 2012).

## 3. Patent and trademark pairs

### *3.1. A case study: AMINEXIL and L'OREAL*

Patents and trademarks are very informative on the timing of the technological and commercial activities of the firm. In patents priority date documents when the invention processes (R&D investments) have taken place, whereas in trademarks the filing date can approximate the timing when a product or service started to be commercialized. Hence, while patents can be considered an output variable of the R&D process, trademarks typically are filed at the inception of the investments in marketing and brand building (Mendonça et al. 2004). The intervening period from patent filing to trademark filing indicates the average time lag needed by a company to translate an idea from laboratory to market. Previous survey evidence has shown that four out of five companies complete the name branding process during the product development phase, which typically gives birth to the filing of a trademark (Kohli and LaBahn, 1997).

A quintessential example of combined strategies of patents and trademarks is the AMINEXIL product by the L'OREAL Corporation, which is a cosmetic treatment against the hair loss. The product is based on a new class of organic chemical compounds, called diaminopyrimidines. It was launched in the market in May 2006, when a mark was filed at the USPTO (serial number 78883916 - AMINEXIL), which was then officially registered by the patent office in about three months.[1] The wordmark of the trademark is exactly labeled AMINEXIL and the so called good and services description explicitly mentions the term diaminopyrimidine. Quite interestingly, L'OREAL had filed a patent application (serial number 2006/097359 - Hair and/or eyelash care composition containing AMINEXIL) through the PCT system some months before the registration of the mark. As in the case of the trademark, the functionality and composition of AMINEXIL are clearly described in the title and abstract of the patent with the same names and words: the title of the patent includes the term AMINEXIL, whereas diaminopyrimidine reads in the abstract. Thus the US mark 78883916 and the PCT patent 2006/097359 are clearly directed to obtain protection for the same innovative project, being that an invention or product targeted to final consumers.

The case of AMINEXIL shows how we can define a patent and trademark pair. The time-to-market of this product is very limited, around one year. The managers of L'OREAL confirm that the patent and trademark pair strategy is deliberate and not an isolated example (Legendre, 2010). Patenting inventions related to a given product, and contemporaneously filing a trademark regarding the same product is a typical IP strategy in the cosmetics industry. The management also monitors the competitors' IP strategies with particular focus on patents, in order to gauge the average time-to-market of new products. They say that patents are a unique source of information to understand the dynamics of new products in the industry.

[1] L'OREAL had adopted the AMINEXIL name as wordmark since 1996 but that mark was already abandoned when the application 78883916 was filed at the USPTO.

*3.2. Matching algorithm*

To identify a patent and trademark pair I semantically compared and matched patent titles with wordmarks. In this task I deviced a matching algorithm relying on string similarity analysis which accounts for differences due to the position of the same word between otherwise identical strings (e.g., AMINEXIL diaminopyrimidine as compared to diaminopyrimidine AMINEXIL). In particular, I implemented the string similarity *J* index proposed by Thoma et al. (2010), which computes the fraction of common words after breaking up the strings into words at the blank spaces and it reads as the following:

$$J(X,Y) = \frac{|X \cap Y|}{|X \cup Y|} \cong \frac{2|X \cap Y|}{|X| + |Y|} \qquad (1)$$

where $X \cap Y$ computes the number of common words between strings *X* and *Y* while $X \cup Y$ computes the total number of distinct words. To reduce the computational complexity the second term of the equation (1) has been approximated, and the denominator is stylized as the sum of all words, including those words that are contained in both strings. This may result in some double counting and thus the numerator is multiplied by two in order to preserve a comparable scale.

To account for frequent words I normalize each word *i* by its statistical weight $w_i$ in the dataset

$$w_i = \frac{1}{\log(n_i) + 1} \qquad (2)$$

where $n_i$ is the frequency of the token in the dataset. Thus, the weighted $J^w$ similarity index is equal to the following expression:

$$J^w(X,Y) = \frac{2\sum_{k|x_k \in X \cap Y} w_k}{\sum_{i|x_i \in X} w_i + \sum_{j|y_j \in Y} w_j} \qquad (3)$$

Where $x_i \in X$ and $y_i \in Y$ and $w_i$ and $w_j$ are the weights inversely correlated with the frequency of tokens $x_i$ and $y_i$ in the dataset; the terms $x_k$ and $w_k$ are respectively the $k^{th}$ token and relative weight belonging to the intersection set $\boldsymbol{X \cap Y}$.

Box 1 depicts some examples of patent and trademark pairs which have been matched using the algorithm proposed by equation (3). As it can be denoted the PTP strategy is pursued by firms of different sizes (large firms vis-à-vis small and medium ones), by private owned firms or those publicly listed in financial markets, and by firms originating from multiple countries. The examples of Box 1 are similar to the AMINEXIL case study, having same names and words both in the patent title and wordmark: from a statistical point view (see Eq. 2) these words are discriminating tokens like AIVLOSIN, ISOMALT, COLOSTRININ, etc. SYNBIOTIC is a outstanding example of a PTP strategy: not only a single discriminating token is used both in the patent title and wordmark, but also the company name itself is labeled with the exact same wording.

**Box 1 Examples of patent and trademark pairs**

| Patent title - wordmark | Patenting firm |
|---|---|
| PRRS VACCINES (EP1838343) - INGELVAC PRRS (US78961723) | BOEHRINGER INGELHEIM VETMEDICA (DE, large firm*) |
| AIVLOSIN FOR THE TREATMENT OF DISEASE DUE TO BRACHYSPIRA PILOSICOLI OR ORNITHOBA (EP1641469) - AIVLOSIN (US78419667) | ECO ANIMAL HEALTH (GB, large firm*) |
| ANTITUMOUR TREATMENTS WITH METXIA-P450 AND CYCLOPHOSPHAMIDE OR 5T4 VACCINE (EP1725252) - METXIA (US75381002) | OXFORD BIOMEDICA (GB, listed firm) |
| NEW SYNBIOTIC USE (EP1715876) - SYNBIOTIC 2000 (US78188920) | SYNBIOTICS (SE) |
| ULTRAPURE ORAL FLUDARA FORMULATION WITH A FAST RELEASING ACTIVE SUBSTANCE (EP1455760) - FLUDARA (US74028100) | SCHERING (DE, large* and listed firm) |
| PEPTIDE FRAGMENTS OF COLOSTRININ (EP1240193) - COLOSTRININ (US76227611) | REGEN THERAPEUTICS (GB) |
| THERAPEUTIC ANTI-COLD AGENT CONTAINING ISOMALT AS AN ACTIVE INGREDIENT (EP1079839) - ISOMALT (US75423821) | SÜDZUCKER MANNHEIM OCHSENFURT (DE, large* and listed firm) |

Notes: My elaboration from different sources and web search last accessed on January 18, 2015. Large firms(*) are those with more than 250 employees.

## 4. Dataset

Because of the particular importance that formal IP strategies have in the pharmaceutical industry I limited the patent valuation analysis on medical and cosmetic products. With about fifteen percent of the annual sales devoted to R&D investments the pharmaceuticals industry has been the top R&D doer for several decades up to date (EFPIA, 2011), and the industry is characterized by an extensive patenting activity (Cockburn, 2004). Trademark strategies are in turn of quintessential importance because drug labeling and naming is regulated by public authorities, who have the goal to protect consumers from medication errors spurring from potential product name confusion. The drug approval process is articulated in several stages involving international and national regulators and the costs of identifying a suitable name are very significant. Von Graevenitz (2013) compares different estimates from primary sources regarding drug name creation costs proving a range between US $ 100 thousand to 700 thousand, and in some cases costs can amount to several millions. In this direction, analyzing the impact of trademark strategies on patent valuation of medical and cosmetic products provides an unique setting for understanding the usage of combined IP strategies.

The dataset of patents and trademarks is built up by integrating several primary and secondary sources. Firstly, from the EPO Worldwide Patent Database and the associated Patent

Register (PatStat, 2012) I have drawn the patent indicators, patent classifications, priority and filing dates, and opposition and renewal decisions. A fuller description is presented by Thoma (2014) in this review, where the reader can find those aspects that are not discussed in this paper. Secondly, from the USPTO CASSIS Database I have extracted bibliographic information on US trademarks (CASSIS, 2007). Thirdly, demographic and financial information on innovating firms originates from the Amadeus business directory (amadeus.bvdinfo.com).

*4.1. Patents for medical and cosmetic products*

In order to define patents for medical and cosmetic products I have relied on the technology grouping elaborated by the Observatoire des Sciences et des Techniques (OST, 2008) which is made up of 30 categories. Patent documents are attributed to a category on the basis of the international patent classification (IPC) codes assigned during the examination independently of the assigned number of codes. In the case of the medical and cosmetic products the identified IPC codes are twofold: "preparations for medical, dental, or toilet purposes" (A61K) and "specific therapeutic activity of chemical compounds or medicinal preparations" (A61P).

*4.2. Composite index*

To account for the heterogeneity of patent value I device a composite index combining several uni-dimensional indicators according to the methodology presented by Thoma (2014). This approach relies on the maximum likehood factor analysis for computation of the composite index and the analyzed uni-dimensional indicators are the following:

i) Patent family given by the number of patents that share the same priority filing;
ii) Patent family weighted by the GDP of the country where the protection is sought;
iii) Number of claims in the frontpage of a patent;
iv) Forward citations received within five years from priority year;
v) Backward citations, excluding non patent references;
vi) XY backward citations in the application search report;
vii) PCT route dummy, indicating whether the patent concerns an international filing;
viii) Supplementary search report dummy.

*4.3. Trademark dataset*

Bibliographic information on US trade and service marks is drawn from the SGML files of the USPTO trademark database (CASSIS, 2007). This data source collects complete bibliographic information on US marks since the inception of the US patent and trademark office, including date of filings, priority, registration, cancellation, description of a mark, goods and services, sectoral classification, and others. Furthermore, I harmonized and integrated trademarks with the patent dataset described in Thoma et al. (2010), which encompassed the universe of the European firms who have filed at least one EPC patent application during the period 1978-2009. It is not noteworthy, that I opted to include US trademark documents, and not those of the European Office for Harmonization in the Internal Market (OHIM) because of the substantially longer and wider coverage of the USPTO with respect to the OHIM during the 1990s, in particular for small and medium sized firms.

### *4.4. Demographic and financial variables*

In the multivariate econometric analysis I control for the demographic characteristics of the company who have filed patents, in order to take into the account several factors at the firm level, that in turn could have an impact on patent value. The task is eased by the fact that the database described in Thoma et al. (2010) allows to link the patents with external information on firm's characteristics. In particular by relying on the Amadeus business directory I built the following control variables at firm level:

- Country of origin: dummies for the country where the firm has been incorporated;

- Listed firm: dummy variable whether the firm is publicly listed in financial markets;

- Size: binary variable with the positive outcome when the firm has more than 250 employees, zero otherwise;

- Cohort dummies: binary variables for business experience according to the year when a firm was founded: between 1971 and 1980, 1981 and 1985, 1986 and 1990, and after year 1990, with those founded prior to 1971 the left-out category.

- Primary business activity: dummies for the main activity code of the firm classified in four industries, that is chemicals, pharmaceuticals, R&D specialized firms, and the other types of firms constitute the left out category;

- Growth of R&D investment: lagged growth of R&D personnel over five year window. The counts of R&D personnel are measured according to the methodology discussed in Harhoff and Thoma (2010).

## 5. Patent valuation

To assess the valuation of a patent and trademark pair I relied on renewal data. For patents kept in force, renewal fees are considered as lower bound revenues that the patent ensures to the owner, and more specifically they concern the minimum level of incremental premium value that the patent protection strategy generates as compared to a world without patents (Schankerman, 1998). Previous studies have argued that the premium value is significantly correlated with the intrinsic asset value of a patent (for an extensive survey see Bessen and Meurer, 2008), and hence it can be concluded that the renewal approach can give broader insights on the valuation of patents.

Drawing on actual data at the patent level, I computed the premium value of patent rights using a similar model as in Schankerman (1998) and Grönqvist (2009). The models of this kind assume that the innovator maximixes the benefits derived from the protection strategy by choosing how many years to keep a patent in force. In particular, the net benefits of a patent from cohort *j* in age *t* are represented as current returns $R_{tj}$ minus the costs of renewal fees $C_{tj}$. Thus the agent optimizes the discounted value on $T$

$$max_{T\in[1,2,\dots,\bar{T}]} V(T) = \sum_{t=1}^{T}(R_{tj} - C_{tj})(1+i)^{-t} \qquad (4)$$

where $\bar{T}$ is the statutory limit to patent protection and $i$ is the discount rate, which is typically assumed at the level of ten percent. The optimal patent maintenance $T^*$ is the first age when $R_{tj}$ - $C_{tj}$ <0, otherwise it coincides with the statutory limit. Renewal fees, $C$, are non/decreasing in age, whereas returns, $R$, are non-increasing in age meaning that in each time $t$ the returns can be expressed as function of initial returns $R_{0j}$. Assuming that the benefits from patents decay with a time invariant rate $d$, then the agent will renew the protection in time $t$ solely when $R_{0j} \geq C_{tj}\prod_{\tau=1}^{t}(1-d_{\tau})^{-1}$.

If $F(R_{0j}, \theta_j)$ denotes the cumulative distribution of initial returns, where $\theta_j$ indicates a vector of parameters, then the proportion of patents from cohort *j* renewed in age *t* is $P_{tj}=1- F(R_{0j}, \theta_j)$, and the log of the initial returns is distributed as $r_{0j} \sim N(\mu_j, \sigma_j)$ with mean $\mu_j$ and standard deviation $\sigma_j$. The owner will renew the patent protection if and only if

$$\frac{r_{0j}-\mu_j}{\sigma_j} \geq \frac{lnC_{tj} - t*\ln(1-d) - \mu_j}{\sigma_j} \qquad (5)$$

which implies that the proportion of patents in cohort *j* that drops out by age *t* is given by $y_{ij} = 1 - P_{tj} = \Phi\ (z_{tj}, \theta_j)$ where $\Phi(.)$ is the standardized normal distribution function with $z_{tj}=lnC_{tj} - t*ln(1-d)$.

For the computation of dollar estimates of the premium value imposed by Eq. (4), I analyze the historical fee schedules for the cohorts 1985-1990 in the U.K. and Germany, whose renewal decisions have been observed from 1985 to 2010. Limiting the analysis to these economies does not constitute a serious drawback because they represent a sufficiently large market to attract the lion's share of designation and renewal decisions at the European level. By December 2010 about 91.3% and 95.1% of the European patents have designated the U.K. and Germany respectively.

Since a deflator for business investment is not available for the overall period, the renewal fees have been deflated using a production index for services with the 2005 as base year. This year has been also the time reference for the exchange rate in PPP US dollars. The decay rate is assumed to be fifteen percent, and the moments of the distribution has been estimated parametrically. Then I drew fifty thousand pseudo-random variables from a lognormal distribution, and calculate $V$ for each of them using Eq. (4). I have not included the granting fees by considering age three of a patent as the inception of the renewal fee schedule. For the 1990 cohort the patent value mean has been estimated in about PPP $ 106 thousand and $ 15 thousand for patents designating Germany and the U.K. respectively, whereas the estimates of the median values have yielded $ 21 thousand and $ 5 thousand.

## 6. Results of the multivariate analysis

To assess the valuation of a patent and trademark pair I regressed a series of linear equations on the log protection value of patents for medical and cosmetic products obtained from Eq(4). I limit the analysis only to business companies, excluding sole inventors and non business organizations. Secondly, I excluded also those patents for which I could not identify the business company who have filed the patent application. Thirdly, I discarded those patents with missing demographic information regarding the patenting company, because it is not available from the original sources (see section 4.4). The final sample size is composed of 4 696 and 4 486 patents designating Germany and the U.K. respectively.

Table 1 and 2 report the descriptive statistics and the correlation results of the PTP strategy with the patent value indicators and firm characteristics. I considered two types of variables related to patent and trademark pairs. On the one hand, I computed the string similarity *J* index as stylized from Eq(3). Secondly, to easy the interpretation of the multivariate analysis I transformed the *J* index into a binary variable, when the string similarity *J* index is below or above a certain threshold. By adopting a conservative approach I consider as the positive outcome only when a PTP equals the top quartile of the relative distribution in terms of string similarity. As it can be denoted from Table 1 patent and trademark pairs constitute a rare IP strategy. Only 4.5% of the patents for medical and cosmetic products are paired with a trademark. This strong skewness in the use of a PTP strategy is coherent with the value distribution of inventions: most innovations fail, but a bunch of them are extremely successful. In addition, the PTP *J* index is positively and significantly correlated with the premium value of patents and the opposition decisions. The majority of patents for medical and cosmetic products are invented by large firms having at least 250 employees, and one third of them are invented by publicly listed firms. A typical firm active in this technology holds patents both in the U.S. and Europe, and in three out of four cases its IP portfolio encompasses also trademarks.

The results of the multivariate analysis are reported in Table 3. The regressions for patents designating Germany are given by Models 1-3, while the other three models regard the UK designations. I have included several control variables defined at the firm level, such as country of origin, listing in financial markets, size, experience as proxied by the cohort dummies, primary business activity, and the growth of R&D investment with its squared term. The standard errors are clustered using the robust estimator at the firm level, in order to take into the account potential omitted factors. In all regressions there is also a dummy whether the focal firm has not filed any patent or trademark at the USPTO during the period considered. These variables account for the potential selection bias deriving from the fact that I am considering only trademarks filed under the US legislation and not other systems. I find that the dummy for no trademark stock enters significantly at five percent level only in the regressions regarding the UK designations, which suggests a potential improvement of the statistical fit by including information on trademark counts not only from the USPTO but also from the national offices where the patenting firms originate from.

The portfolios of large sized firms are featured by a higher patent premium value, which is consistent with previous literature that have claimed that small firms may often lack the complementary assets to develop and successfully commercialize an invention (Schankerman and Lanjouw, 2004; Bessen and Meurer, 2008). In particular I find that large firms are characterized by a bigger premium value of PPP $ 536 thousand in Germany and $ 93 thousand in the United Kingdom. Quite interestingly it can be denoted an U shaped relationship with respect to the R&D investment growth (Fleming, 2004).While the first order statistical effect of the growth of R&D investment is negative, its squared term has the converse sign. Put differently increasing the R&D investment is associated on average with lower expected returns, although some extremely valuable inventions are patented by those firms whose R&D investment has achieved a certain scale.

Model 2 and 5 measure the impact of pairing strategy in terms of the string similarity $J$ index, whereas Models 3 and 6 include it as binary variable. I find that the PTP strategy is positively and significantly correlated with the premium value of patents in all specifications which confirms the signaling function hypothesis. The joint use of patents and trademarks constitute a signal for competitors, investors, or commercial partners that the underlying focal invention is highly valuable from a commercial point of view. In particular, one additional PTP generates an increase of the log premium value with about 41.4 and 33.5 percentage points in Germany and in the U.K. respectively. Quite interestingly, the coefficients of the composite index and opposition decisions show no significant variations when the PTP measures are considered (The Wald test is insignificant even at ten percent level). Thus it can be concluded that the composite index and the PTP strategy approximate distinct dimensions of the patent premium value, and more generally it confirms the validity of the pairing strategy in predicting the patent valuation as compared to the indicators adopted in the previous literature (Nagaoka et al. 2010).

In absolute numbers one PTP is associated with about PPP $ 771 thousand bigger premium value for a patent designating Germany and $ 124 thousand for an UK designated patent. In other words for small firms combining patents and trademarks for a given innovative project outplays their premium value disadvantage as compared to large ones. The computation of a 95% confidence interval confirms that the lower limit estimate of the value impact of the PTP strategy is about PPP $ 11 thousand irrespectively of the country of designation. The differences in the mean values could be explained not only with higher valuation of patents in the German legislation but also with a bigger market potential of that system.

## Conclusions

In this paper I have analyzed how trademark strategies which are combined with patenting on same innovative project affect the premium value of patents. I defined this kind of IP strategy patent and trademark pairs, and I claim that they can function as signals for competitors, investors, or commercial partners regarding the economic value of the patented invention. I confirm this view by analyzing the premium value of patents for medical and cosmetic products. The premium value of patents has been computed with the mean of an ad-hoc dataset of renewal decisions and historical renewal fees. Future research could assess the valuation of patent and trademark pairs in other contexts.

## References


Bao, Y., Shao, A.T., and Rivers, D.(2008) Creating new brand names: effects of relevance, connotation, and pronunciation, *J Advertising Res*, 48 (1), 148-162

Bessen J., Meurer M. (2008). Patent failure: how judges, bureaucrats and lawyers put innovators at risk, Princeton University Press, Princeton (NJ).

Block J. H., G. De Vries, J. H. Schumann, P. Sandner (2014), Trademarks and venture capital valuation, *J Business Venturing*, 29: 525–542.

CASSIS (2007). US Bibliometric trademark database: SGML files in the CD Version October 2007, US Patent and Trademark and Office, Washington (DC).

Chesbrough H. (2003). Open innovation: the new imperative for creating and profiting from technology, Harvard Business School Press, Cambridge (MA).

Cockburn I. M. (2004). The changing structure of the pharmaceutical industry, *Health Affairs*, 23(1)10-22.

Cockburn I., M. McGarvie (2007). Patents, thickets and the financing of early-stage firms: evidence from the software industry, *J Econ Manag Strat*, 18(3):729–773.

Conti A., M. Thursby, F. Rothaermel (2013 A). Show me the right stuff: signals for high-tech startups, *J Econ Manag Strat*, 22(2):341–364.

Conti A., M. Thursby, J. Thursby (2013 B). Patents as signals for startup financing, NBER Working Paper No. 19191, National Bureau of Economic Research, Inc. Cambridge (MA).

Buddelmeyer H., P. Jensen, E. Webster (2010). Innovation and the determinants of company survival, *Oxford Econ Pap*, 62(2):261-285.

EFPIA (2011). The pharmaceutical industry in figures, report published by the European Federation of Pharmaceutical Industries and Associations, available at www.efpia.eu.

Fleming L. (2004). Perfecting Cross-Pollination, *Harvard Bus Rev*, 82:22-24.

Gambardella A. (2013). The economic value of patented inventions: Thoughts and some open questions, *Int J Ind Organ*, 31: 626–633.

Gambardella A., A. McGahan (2010). Business-model innovation: General Purpose Technologies and their implications for industry structure, *Long Range Plan*, 43:262-71.

Gans J. S., S. Stern (2003). The product market and the market for ideas: commercialization strategies for technology entrepreneurs, *Res Pol*, 32:333–350.

Graham S., A. Marco, A. F. Myers (2014). Monetizing marks, insights from the USPTO trademark assignment dataset, USPTO Economic Working Paper No. 2014-2.

Greenhalgh C., M. Rogers (2006). The value of innovation: The interaction of competition, R&D and IP, *Res Pol,* 35:562-580.

Grönqvist C. (2009) The private value of patents by patent characteristics: evidence from Finland, *J Technol Transfer*, 34(2):159-168.

Hall B. H., D. Harhoff (2012). Recent research on the economics of patents, *Annu Rev Econ*, 4:541-565.

Harhoff D., G. Thoma (2010). Inventor location and the globalization of R&D, Paper presented at the *Conference on Patent Statistics on Decision Makers*, 17-18 November 2010, Vienna, Austria.

Häussler C., D. Harhoff, E. Mueller (2014). How patenting informs VC investors – The case of biotechnology, *Res Pol*, 43(8):1286–1298.

Helmers C., M. Rogers (2010). Innovation and the survival of new firms in the UK, *Rev Ind Organ*, 36:227–248.

Helmers C., M. Rogers (2011). Does patenting help high-tech start-ups? *Res Pol*, 40:1016-27.

Hoenen S., C. Kolympiris, W. Schoenmakers, N. Kalaitzandonakes (2014). The diminishing signaling value of patents between early rounds of venture capital financing, *Res Pol,* 43:956–989.

Hsu D., R. Ziedonis (2013). Resources as dual sources of advantage: Implications for valuing entrepreneurial-firm patents, *Strat Manag J*, 34:761-781.

Kohli, C. and LaBahn, D.W.(1997) Creating effective brand names: a study of the naming process, *J Advertising Res*, 37, 67–75.

Korkeamäki T., T. Takalo (2013). Valuation of innovation and intellectual property: The case of iPhone, *Eur Manag Rev*, 10:197–210.

Lanjouw J. O., M. Schankerman (2004). Protecting intellectual property rights: are small firms handicapped? *J Law Econ*, 47(1):45-74.

Legendre J. Y. (2010). Combination of patent indices and product data can help understanding product innovation strategies, Paper presented at the *Conference on Patent Statistics on Decision Makers*, 17-18 November 2010, Vienna, Austria.

Mann R. J., T. W. Sager (2007). Patents, venture capital, and software start-ups, *Res Pol,* 36: 193–208.

Mendonça S., T. S. Pereira, Tiago, M. M. Godinho (2004). Trademarks as an indicator of innovation and industrial change, *Res Pol*, 33(9):1385-1404.

Nagaoka S., K. Motohashi, A. Goto (2010). Patent statistics as innovation indicators, in the Handbook of the Economics of Innovation, B. H. Hall and N. Rosenberg (eds.), April 2010, Ebook Elsevier.

OST (2008), Science and technology indicators 2008 *Observatoire des Sciences et des Techniques*, Paris.

Rujas J. (1999). Trademarks: complementary to patents, *World Pat Inform*, 21:35-39.

PatStat (2012). EPO Worldwide Patent Statistical Database – Available under license from OECD-EPO Task Force on Patent Statistics, April 2012. It includes an upgrade to the EPO Patent Register.

Sander P. and J. Block (2011), The market value of R&D, patents, and trademarks, *Res Pol*, 40:969-985.

Schankerman M. (1998). How valuable is patent protection: Estimates by technology fields, *Rand J Econ*, 29(1):77-107.

Squicciarini M., V. Millot, H. Dernis (2012). Universities trademark patterns and possible determinants, *Econ Innov New Technol,* 21(5–6):473–504.

Teece D. (1986). Profiting from technological innovation. *Res Pol*, 15(6):285–305.

Thoma G. (2014). Composite index of patent indicators: factor analysis combining bibliographic and survey datasets, *World Pat Inform*, 38:19-26.

Thoma G., S. Torrisi, A. Gambardella, D. Guellec, B. H. Hall, D. Harhoff (2010). Harmonizing and combining large datasets – an application to firm-level patent and accounting data, NBER Working Paper No. 15851, National Bureau of Economic Research Inc., Cambridge (MA).

Von Graevenitz G. (2013), Trade mark cluttering–evidence from EU enlargement, *Oxford Econ Pap*, 65(3):721–745.

**Table 1 Descriptive statistics**

| | Germany | | | United Kingdom | | |
|---|---|---|---|---|---|---|
| | *Mean* | *Standard Deviation* | *Median* | *Mean* | *Standard Deviation* | *Median* |
| Log (Patent premium) | 9.604 | 2.218 | 9.597 | 8.832 | 1.672 | 8.686 |
| Patent Trademark Pair - *J index* | 0.023 | 0.059 | 0.000 | 0.023 | 0.059 | 0.000 |
| D (Patent Trademark Pair) | 0.046 | 0.210 | 0.000 | 0.045 | 0.208 | 0.000 |
| Composite index | 0.262 | 0.755 | 0.175 | 0.263 | 0.745 | 0.174 |
| D (Opposition) | 0.082 | 0.274 | 0.000 | 0.082 | 0.275 | 0.000 |
| D (No US patent) | 0.086 | 0.280 | 0.000 | 0.087 | 0.282 | 0.000 |
| D (No trademark) | 0.261 | 0.439 | 0.000 | 0.261 | 0.439 | 0.000 |
| D (Large firm) | 0.717 | 0.450 | 1.000 | 0.722 | 0.448 | 1.000 |
| D (Listed firm) | 0.311 | 0.463 | 0.000 | 0.313 | 0.464 | 0.000 |
| R&D investment 5 years growth | 0.775 | 0.746 | 0.526 | 0.773 | 0.738 | 0.527 |
| R&D investment 5 years growth squared | 1.157 | 2.300 | 0.277 | 1.143 | 2.270 | 0.277 |

Notes: Sample size: n=4 696 for Germany; n=4 486 for the U.K; n=4 769 for the overall dataset.

**Table 2 Pairwise correlations: pooled sample**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Log (Patent premium) | 1.000 | | | | | | | | | | |
| 2. Patent Trademark Pair - *J index* | 0.028 | 1.000 | | | | | | | | | |
| 3. D (Patent Trademark Pair) | 0.018 | 0.800 | 1.000 | | | | | | | | |
| 4. Composite index | 0.291 | -0.054 | -0.063 | 1.000 | | | | | | | |
| 5. D (Opposition) | 0.119 | 0.035 | 0.032 | 0.105 | 1.000 | | | | | | |
| 6. D (No US patent) | 0.042 | -0.089 | -0.057 | 0.017 | 0.054 | 1.000 | | | | | |
| 7. D (No trademark) | -0.004 | -0.225 | -0.129 | 0.042 | -0.013 | 0.158 | 1.000 | | | | |
| 8. D (Large firm) | 0.015 | 0.221 | 0.134 | -0.030 | -0.026 | -0.072 | -0.447 | 1.000 | | | |
| 9. D (Listed firm) | -0.013 | 0.376 | 0.275 | -0.036 | -0.009 | -0.160 | -0.389 | 0.419 | 1.000 | | |
| 10. R&D invest. 5 years growth | 0.043 | -0.050 | -0.060 | 0.071 | 0.048 | 0.168 | 0.074 | -0.083 | -0.155 | 1.000 | |
| 11. R&D invest. 5 years growth squared | 0.049 | -0.067 | -0.065 | 0.067 | 0.058 | 0.170 | 0.083 | -0.076 | -0.149 | 0.932 | 1.000 |

Notes: Coefficients above 0.028 are statistically significant at five percent level (N=4 769)

**Table 3 Log linear regression results with clustered standard errors**
**Dependent variable: log value of patent rights (US 2005 PPP $)**

| | Germany | | | | | | United Kingdom | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Model 1* | | *Model 2* | | *Model 3* | | *Model 4* | | *Model 5* | | *Model 6* | |
| | *coeff.* | *s.e.* | *coeff.* | *s.e.* | *coeff.* | *s.e.* | *coeff.* | *s.e.* | *coeff.* | *s.e.* | *coeff.* | *s.e.* |
| Patent Trademark Pair - *J index* | | | 1.728 | [0.694] ** | | | | | 1.266 | [0.560] ** | | |
| D (Patent Trademark Pair) | | | | | 0.414 | [0.180] ** | | | | | 0.335 | [0.114] *** |
| Composite index | 0.798 | [0.057] *** | 0.801 | [0.057] *** | 0.801 | [0.057] *** | 0.501 | [0.046] *** | 0.504 | [0.046] *** | 0.504 | [0.046] *** |
| D (Opposition) | 0.604 | [0.141] *** | 0.587 | [0.141] *** | 0.591 | [0.141] *** | 0.476 | [0.115] *** | 0.464 | [0.115] *** | 0.466 | [0.115] *** |
| D (No US patents) | 0.090 | [0.196] | 0.101 | [0.196] | 0.096 | [0.196] | 0.063 | [0.150] | 0.071 | [0.150] | 0.068 | [0.150] |
| D (No trademark) | -0.243 | [0.145] * | -0.230 | [0.145] | -0.242 | [0.144] * | -0.220 | [0.110] ** | -0.209 | [0.111] * | -0.218 | [0.109] ** |
| D (Large firm) | 0.393 | [0.159] ** | 0.366 | [0.157] ** | 0.377 | [0.157] ** | 0.319 | [0.135] ** | 0.297 | [0.135] ** | 0.304 | [0.135] ** |
| D (Listed firm) | -0.038 | [0.123] | -0.101 | [0.121] | -0.084 | [0.121] | -0.039 | [0.101] | -0.084 | [0.102] | -0.074 | [0.102] |
| R&D investment 5 years growth | -0.294 | [0.158] * | -0.309 | [0.155] ** | -0.299 | [0.155] * | -0.239 | [0.121] ** | -0.251 | [0.119] ** | -0.245 | [0.119] ** |
| R&D investment 5 years growth squared | 0.089 | [0.048] * | 0.093 | [0.048] * | 0.091 | [0.048] * | 0.082 | [0.038] ** | 0.085 | [0.038] ** | 0.084 | [0.038] ** |
| D (Chemical firm) | -0.155 | [0.186] | -0.158 | [0.185] | -0.160 | [0.184] | -0.151 | [0.147] | -0.150 | [0.147] | -0.153 | [0.146] |
| D (Pharmaceutical firm) | -0.153 | [0.143] | -0.136 | [0.142] | -0.134 | [0.142] | -0.155 | [0.114] | -0.142 | [0.115] | -0.139 | [0.115] |
| D (R&D specialized firm) | -0.025 | [0.180] | -0.030 | [0.181] | -0.023 | [0.180] | -0.063 | [0.160] | -0.066 | [0.161] | -0.062 | [0.160] |
| Costant | 8.492 | [0.909] *** | 8.500 | [0.913] *** | 8.493 | [0.910] *** | 8.004 | [0.749] *** | 8.008 | [0.752] *** | 8.003 | [0.750] *** |
| Application year dummies (6) | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Geographic origin dummies (17) | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| Cohort dummies (5) | Yes | | Yes | | Yes | | Yes | | Yes | | Yes | |
| F-test primary business activity (3) | 0.45 | | 0.38 | | 0.39 | | 0.65 | | 0.55 | | 0.55 | |
| F-test geographic origin (17) | 10.17 | *** | 11.53 | *** | 11.14 | *** | 10.11 | *** | 11.63 | *** | 11.18 | *** |
| F-test cohorts dummies (5) | 1.32 | | 1.34 | | 1.29 | | 0.81 | | 0.83 | | 0.80 | |
| F-test all firm charact. (31) | 6.87 | *** | 7.85 | *** | 7.50 | *** | 6.67 | *** | 7.89 | *** | 7.52 | *** |
| Observations | 4 696 | | 4 696 | | 4 696 | | 4 486 | | 4 486 | | 4 486 | |
| Adjusted R2 | 0.120 | | 0.122 | | 0.121 | | 0.095 | | 0.097 | | 0.097 | |

Notes: 1) *** indicates statistically significant at 1% level; **5% level and * 10% level.

2) Standard errors are reported in square brackets.

3) The clustering estimator is computed at the firm level.