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Explaining the Trademark-Innovation Linkage: the Role of Patents and Trademark Filing Strategies.

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Abstract

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Jelcodes:O34,O3

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ABSTRACT

The use of trademark data in innovation studies is in its infancy, but the results of the first empirical studies are promising. However, since there is no one-to-one relationship between trademarks and innovation, the use of raw trademark counts has important drawbacks, particularly in firm-level studies. We contribute in two ways to further explain when individual trademarks refer to innovation. First, we discuss how trademarks data are complementary to information on patenting. Secondly, we investigate how trademark filing strategy provide clues on the trademark-innovation linkage, especially for unpatented innovations. We empirically test our hypotheses with survey data of new trademark applicants at the Benelux and European trademarks offices. We find that trademark applications combined with patent application more frequently refer to innovation, also radical one. Also, trademarks filed for brand creation or extension purposes more frequently refer to both patented and unpatented innovations as opposed to trademarks filed for other branding purposes.

Keywords: trademarks; innovation; measurement; matched data

JEL classification: O34, O39

1. INTRODUCTION

Research into the relationship between trademark activity and innovation is in its infancy (Schautschick and Greenhalgh, 2013; Graham and Hancock, 2014). Results from the empirical studies so far, however, are promising. They find positive correlations between the firm-level use of trademarks and firm-level proxies of innovation (Allegrezza and Guarda-Rauchs, 1999; Schmoch, 2003; Jennewein, 2005; Jensen and Webster, 2009; Götch and Hipp, 2012). This supports the view that trademarks may be relevant for measuring innovation, as discussed in the pioneering paper by Mendonca *et al.* (2004).

Still, the overwhelming majority of innovation studies use patents and R&D expenses as preferred innovation indicators (Malecki, 2013). There is only a keen interest by economists in trademarks in a handful of studies, although it is slightly increasing. This is in line with the long-standing focus of innovation studies on technological innovation. What needs to happen to diffuse the use of trademark data in innovation research practice? In this paper we contend that innovation research can profit from a more systematic understanding of the variables predicting the link between new trademarks and innovation. While raw trademark counts have several limitations, the heavily unexplored information contained in trademark records and additional information on trademark applicants from other data sources can enable predicting the proportion of trademarks actually referring to innovation.

In this paper we empirically study whether differences in *case-level* trademark filing strategies and *firm-level* track records of patent application explain the reference of new trademarks to innovation. We also study differences between radical and incremental innovations and for start-ups and mature firms. Our first contribution is that the combination of trademark data with information on patent applications facilitates discriminating those trademarks referring

to innovation. Obviously, patents are a valid indicator of inventions and front-end activities in the innovation value chain (Hansen and Birkinshaw, 2007), while trademarks are better fit to signal market introduction. While only a limited share of patents leads to commercialization (Sichelman, 2010), only some of the trademarks can be traced back to different forms of innovation. We find that new trademarks owned by firms with a track record of patent application predominantly indicate back-end activities in the innovation value chain. Trademark data may therefore also be used to purge patent statistics used for innovation research purposes.

The second contribution of this study is that we research non-patented innovations. Only a small share of the trademark applicants in our study had a patent portfolio. An important number of the remaining companies however reported innovation activities as well. Our study aims to identify the trademark filing strategies employed by these companies for appropriation purposes. These strategies, proposed by Block *et al.* (2014), exploit information on the whole trademark portfolio of applicants. By doing so we are able to identify innovations that do not show up in patent statistics, but can be identified with information from trademark databases.

In section 2 we review the key studies exploring the relationship between trademark activity and innovation to show the current state of thinking about trademarks and innovation. Subsequently, in section 3 we explore the role of patents and trademark filing strategies in explaining the trademark innovation linkage, and we disentangle hypotheses. We distinguish case-level IP strategies that include both patent and trademark application from IP strategies with the stand-alone use of trademarks. In section 4 we describe our research approach, data sources and sample characteristics, while section 5 presents the results of regression analyses. We end with conclusions, limitations and an agenda for future research with IPR data, including trademarks.

2. A REVIEW OF STUDIES ABOUT TRADEMARKS AND INNOVATION

Trademark law provides economic agents with the opportunity to protect brand owners against imitation. Trademarks identify the origin of goods and services and thereby provide protection to both sellers and buyers (Greer, 1979), namely protection against deception and fraud to buyers, and to some extent protection of monopolies established by differentiation efforts to sellers. Strictly, however, trademarks do not protect IP like patents do, since an inventive step and non-obviousness is not required to apply successfully for trademarks. From casuistics we know that firms sometimes use new brands and apply for new trademarks in cases of meaningless or nil differentiation, to prolong other IP rights (Statman, 1981; Rujas, 1999; Jain and Conley, 2014), to leverage brand equity (Kocyigit and Ringle, 2011; Block *et al*., 2014), to avoid trademark squatting (Helmers *et al.* 2013), to pack product spaces (Reitzig, 2004), to control franchisees (Ramello, 2006), to support the low risk entry in foreign markets (Giarratana and Torrisi, 2010), to enable ingredient marketing (Reitzig, 2004), to protect slogans or for brand substitution purposes. We can therefore conclude that the use of raw trademark counts in innovation studies has several potential drawbacks in particular for firm-level research.

Nevertheless, the potential of trademark data for innovation research has been claimed in a seminal paper by Mendonça *et al.* (2004). Although there are some limitations, there are several reasons why trademarks have the potential to be a new indicator for innovation, especially in services. First, trademarks are widely used by service firms either in combination with or as substitutes for patents (Blind *et al.*, 2003). Some technical service firms may be able to patent the technological components of a tool which enables providing a new service, but they may still trademark the intangible part of their innovation, which results from the configuration of new technological options and non-technological assets or soft technologies (Den Hertog,

2000). Second, while patents refer more to inventions than innovations, trademarks capture inventions being commercialized. In this sense they may be considered as output indicators, while patents should be considered predominantly as a deliverable or an output of the R&D process (Somaya *et al.*, 2007). Moreover patents can only be applied when the innovation is new-to-the-world. A patent cannot be applied when the innovation is only new-to-the-firm or sector. Third, trademarks also capture non-technological types of innovation, in particular new marketing solutions (Millot, 2009). Fourth, trademarks can be collected systematically from trademark offices[1] and are classified as protecting a good/service or a combination thereof with a detailed classification system (Economides, 1998; Schmoch and Gauch, 2009). Finally, they also represent a meaningful indicator at different levels of aggregation: firm, sector or country.

The empirical evidence collected to support the claim that trademarks signal innovation indicates a positive correlation between trademarking and innovative activities, but typically raw trademark counts are used or dichotomies like the firm-level (yes/no) usage of trademarks, which makes it hard to disentangle different innovation processes, projects and portfolios. A review of all studies in which the trademark-innovation linkage has been explored (see also Table 1), shows that many questions remain around the trademark-innovation relationship. A case-level approach, i.e. studying the characteristics of individual trademarks, may provide a way forward.

Insert Table 1 about here

First, based on a large cross country database Baroncelli *et al.* (2005) show that the highest use of trademarks across the world occurs in the scientific equipment and

[1] Since 1996 European firms can apply for Community Trademarks at the OHIM and an online database allows to search all registered or pending marks. The American office (USPTO) also offers an online search with a complete coverage going back to 1984.

pharmaceuticals sectors, which they categorize as being R&D-intensive. This is remarkable considering the fact that the scientific equipment sector is a B2B-sector where brands and trademarks seem to be less relevant (Malmberg, 2005). Similarly, Allegrezza and Guard-Rauchs (1999), Jensen and Webster (2009) and Daizadeh (2009) show positive correlation between R&D intensity and trademarking intensity, at respectively the firm-level, sector-level and country-level. However, given the small range of industries in which firms conduct formal R&D, mainly manufacturing, these studies are by no means definitive, as Schautschick and Greenhalgh (2013) rightfully address. The lack of formal R&D seems to hold in particular for low-tech and service industries. Therefore, Schmoch (2003) and Götsch and Hipp (2012) use German CIS data to explore the correlation between the sales share of new products and services, and trademark use. They find positive and significant correlation between their innovation proxy and trademark use for high-tech manufacturers and knowledge intensive business service firms (KIBS). The relatively strong importance of trademarks for IP protection in KIBS industries was also found in empirical studies of Miles *et al.* (2000) and Amara *et al.* (2008). The latter found that KIBS involved in IP protection use trademarks twice as frequently as patents. The dominance of trademarks in IP strategies was also found in a services sector study of Blind *et al.* (2003) and an SME-study of Kitching and Blackburn (1998). The scope of their study, however, was limited to high-tech industries: computer software, design, electronics and mechanical engineering.

Jensen and Webster (2009) propose another innovation proxy based on information collected with thirteen survey items. They find positive and significant correlation between innovation activity and trademark applications at the firm-level, but remarkably not between innovation activity in general and patent application. However, the level of correlation is rather low (<.1). According to their empirical study the correlation is strongest for product innovation

and marketing innovation. Process innovation and organizational innovation efforts were not significantly related to trademark activity, which was also confirmed by the studies of Götsch and Hipp (2012) for process innovation, by Flikkema *et al.* (2014) for organizational innovation and by Millot (2012) for both. Flikkema *et al.* (2014), however, did not confirm the lack of correlation between trademark activity and process innovation.

There are only two studies looking at single trademarks: Malmberg (2005) focuses in a longitudinal case study on the firm-level propensity to trademark product innovations and distinguishes between general trademarks (company name or marketing slogans) and trademarks signaling new products and services, and Flikkema *et al.* (2014) look at the motives behind the registration of a sample of Benelux trademarks and the case-level linkages with innovative activity and output. The preliminary conclusion of these studies is also that the relationship between trademark activity and innovation is highly dependent on the sector, market and innovation type (see also Jensen and Webster, 2009).

We can conclude that although there is evidently a link between trademark filing and innovation, we need to better understand why and when firms apply for trademarks to appropriate the rents from innovation. We propose that it makes sense to distinguish between firms which try to capitalize on patent portfolios and firms which try to capitalize on the results from search processes that are not patented. For the first category of firms trademark and patents can be considered as complements, while in the latter category trademarks can be considered as substitutes for patents or at least as standalone complementary resources (Teece, 1986) for appropriating the rents from innovation. We will study antecedents of the trademark innovation linkage in depth in the next subsection.

3. IDENTIFYING THE TRADEMARK INNOVATION LINKAGE

3.1. The role of the joint use of patents and trademarks.

Firms apply for patents both for offensive and defensive reasons (Arundel and Patel, 2003). Defensive patenting means preventing other firms to apply for a patent, even though the patent applicant does not intend to commercialize it, at least not in the short run (Blind *et al.*, 2009). It is therefore unlikely that in these cases, firms also engage in trademark filing. The combination of patents and trademarks seems to be most relevant in cases of offensive patenting. It is intuitively conceivable that firms use trademarks to announce the introduction of new products and services, because patented inventions do not speak for themselves (Schwiebacher and Müller, 2009). Trademarks and patents can therefore often be considered as complementary (Teece, 1986; Graham and Somaya, 2004; Millot and Llerena, 2013). They provide the inventor with an opportunity to uniquely brand products or services that are developed for patent valorization purposes. Competitors might benefit from these patents if they imitate the brand(s) used in the patent valorization process, or if they introduce highly similar brands for inferior products. Customers may interpret them as 'two of a kind', and shift their attention from product features to other features, such as price. Brand dilution and a loss of revenues might be the consequence.

Trademark protected brands can establish sustainable relationships between customers and producers and may thereby also help companies to fend off patent infringement issues, or to reduce the resources needed for patent litigation. We therefore expect that:

Hypothesis 1: The combination of trademark and patent application is positively related to the likelihood that a new trademark refers to innovation.

It is difficult to match trademark records with patent records (Thoma and Torrisi, 2007). Until now, the joint use of trademarks and patents at the case-level can only be established in a reliable way with survey efforts. However, for innovation research purposes it might be sufficient to know that a trademark applicant was engaged in processes of invention in the (recent) past. Firm-level patent portfolios can be considered as a valid indication hereof. Therefore we will compare the predictive power of trademark and patent bundling with the predictive power of firm-level track records of patent application. This can be considered as an extension of the case-level trademark study by Flikkema *et al.* (2014), which only did the former.

For various reasons there is no one-to-one relationship between patenting and trademark filing. First, not all patents are being marketed (Sichelman, 2010). This holds in particular for patents owned by small firms (Brouwer and Kleinknecht, 1999). Second, sometimes patents strongly overlap and patent portfolios are used to simultaneously create market place protection for innovations (Parchomovsky and Wagner, 2005). Third, new products and services are not the only means of monetizing patents. Firms also use (cross) licensing agreements to benefit from patented inventions. Fourth, firms may also benefit from patents through process innovations (Arundel and Kabla, 1998), for which the need to engage in trademark application seems to be less apparent. Fifth, the literature on branding focusing on product differentiation shows that in many cases firms prefer to use existing brands to enter new product and service categories in the hope of leveraging trust in the brand and to reduce introduction costs (Xie, 2008; Satler *et al.*, 2010). One way to capture cross-firm differences in IP strategies is to look at the firm-level trademark/patent ratio. The trademark/patent ratio of a firm is the size of its trademark portfolio divided by the size of its patent portfolio. If a firm has a relatively large number of trademarks then it may have succeeded more frequently in moving a patent to the market. If the

trademark/patent ratio is indeed a valid indicator of a firm's ability to invent *and* to move inventions to the market then one may argue that the relationship between the trademark/patent ratio and the reference of new trademarks to innovation is positive for firms with a track record of patent application. This might hold particularly for trademark applicants in *b2c* markets, since there is case-based evidence that new products in *b2c* markets are frequently marketed with new serial numbers (Malmberg, 2005). It is therefore reasonable to assume that the propensity to trademark patented innovations is lower in *b2b* markets. However, it may also turn out that the trademark/patent ratio is predominantly an indication of the extent to which a firm *is* able to capitalize on at least one of its patents, or *was*. Some firms may own just one or a few valuable patents, granted a long time ago, and many trademarks. A new trademark that complements these firms' large trademark portfolios may then be filed to continue the capitalization process, for example through brand modernization in domestic markets (Block *et al.*, 2014), brand creation for foreign markets, to protect a slogan, or for patent substitution purposes after patent expiry. Moreover, some firms pursue a branded house strategy (Aaker, 2004). This means that they market all products and services with a single brand. In hypothesis 2 we combine the two views about the meaning of the firm-level trademark/patent ratio as described above.

> *Hypothesis 2:* For trademark applicants using patents, the firm-level trademark/patent ratio is positively related with the reference to innovation of new trademark filings.

The propensity to patent innovations varies strongly between industries (Arundel and Kabla, 1998) and firms (Brouwer and Kleinknecht, 1999). This is a consequence of several factors: invention and firm characteristics, appropriability regimes, market factors and IP-related policies (De Rassenfosse *et al.*, 2010). For example in service industries as well as in personal goods industries

just a limited number of the innovators is engaged in patent application (Castellacci, 2008). In the next subsection we will explore whether information contained in new trademark records and additional information on trademark applicants from other sources may help to predict the proportion of trademarks referring to innovation, when applicants have no track record of patent application. That is where this study aims to make a second contribution, with the first attempt to identify distinctive trademark filing strategies for innovation purposes.

3.2. The distinctiveness of trademark filing strategies for innovation purposes.

'Most incremental innovations represent only very small changes over existing goods, or new combinations of existing goods, neither of which represent the kind of "inventive step" necessary to qualify for patent protection' (Davis, 2006, p. 11). Davis argues that therefore the 'standalone' use of new trademarks makes particularly sense for incremental innovations, to signal newness and to enhance the perceived differentiation of new offers (Flikkema *et al.*, 2014). However, some firms may also lack the resources to apply for patents (Flikkema *et al.*, 2014) and some radical innovations are simply not patentable (Hall *et al.*, 2013), in particular in service industries (Leiponen, 2012).

Sandner (2009) and Block *et al.* (2013) distinguish several trademark filing strategies, including, *brand-creating, brand-modernizing and brand-extending* derived from literature into brand management and IP law. According to Block *et al.* (2013) brand creation is required if a firm wants to tap into new market segments where they cannot capitalize on the equity of parent brands. They consider brand-modernizing as the renovation of existing brands to keep up its appearance up-to-date (Sandner, 2009), to discard unwanted associations in changing environments, to signal revitalization and ongoing market presence, or to improve the fit with a product's life cycle. 'With brand extending strategies companies build upon an established brand and seek to induce spillover effects by transferring this brand to other products or markets' (Block *et al.*, 2013 p. 4). Consider for

example *McKinsey Solutions*, which is a figurative trademark used to brand a service line extension of McKinsey & Company. The figurative trademark *WAVE*, owned by McKinsey as well, is instead created to identify a new program management tool that supports transformation and change programs. This is obviously an example of a brand creation strategy. While both brand creation and brand extension strategies indicate market and product differentiation and may hint to forms of innovation, brand modernization does not have any clear link to the signaling of new products or services. We therefore hypothesize that

> *Hypothesis 3* Trademarks filed for brand creation or brand extension purposes refer more frequently to innovation than trademarks filed for brand modernization.

But for what reasons should applicants extend a parent brand or even create a new brand without any effort to differentiate a product or service? A valid reason might be to make potential customers think that *complex* products are customized to sector needs, which may be an effective branding strategy in case of goods with credence qualities. Another valid reason might be to make customers think that the trademark applicant is not a one-day-fly, but really dedicated to serve new market segments. Finally, brand extension in cases of nil differentiation may also be applied to signal market entrance to other stakeholders, in particular competitors, to position competitively (Semadeni, 2006 and Semadeni and Anderson, 2010). Only by means of an empirical study one can test the validity of the three arguments described above and Davis' hypothesis that to benefit from the equity embedded in other brands, it is likely that applicants predominantly pursue brand extension strategies for incremental innovations (Davis, 2006):

Hypothesis 4 New trademarks filed by applicants who pursue brand extension strategies refer relatively more frequently to incremental rather than radical innovation than trademarks filed by applicants who pursue brand creation strategies.

In the current study, we consider both national (Benelux Trademarks or BTMs) and EU-trademarks (Community Trademarks or CTMs). We tend to believe that CTMs refer more frequently to innovation, relatively more frequently to product innovation, and relatively more frequently to radical innovations than BTMs, because firms often have to internationalize for a moderate or high return on investments in radical innovation and firms still struggle with up scaling new services beyond home markets or with the export of services, although the growth of e-services might have changed this significantly. Second, we are able to distinguish between trademarks filed with the help of trademark attorneys and *pro se* applicants. Trademark attorneys are not a prerequisite for pursuing a successful trademark application, but they seem to significantly increase the likelihood of success (Gerhardt and McClanahan, 2013). Their involvement may therefore be particularly relevant in cases of radical innovation, with high-risk and large investments, to ensure that the innovator earns sufficient rents from innovation. If that is a valid argument then trademarks filed with the help of attorneys refer more frequently to innovation and relatively frequently to radical innovation. Probably also relatively frequently to *product* innovation and for the same reason: relatively high investments in new products as opposed to investments in new services, which in many cases 'happen' (Menor *et al.*, 2002), are outputs of providing services (Den Hertog, 2000) or at least semi-finished prerequisites for new service offers (Flikkema *et al.*, 2007). Opponents, however, would emphasize that the design of distinctive brands is particularly relevant in case of new intangible service offers, to make the intangible tangible. This may imply the need for involving trademark experts particularly in

these cases. However, we tend to believe that for the branding of low-risk innovations trademark attorneys are brought in less frequently. A third aspect of trademark filing strategies we consider is the breadth of a trademark registration. With trademark breadth we mean the number of Nice classes covered in a single trademark record. According to Sandner (2009, p.44) 'those trademarks associated with few Nice classes tend to protect single products or narrow product lines, while umbrella brands seem to cover multiple classes'. We therefore tend to believe that umbrella brands are used as trade names predominantly, while new product brands are part of the product management strategy for new products.

To be able to test our hypotheses and the role of the three aspects of trademark filing strategies mentioned above, we have collected information with the second version of the TIS survey (Flikkema *et al.*, 2014) and through data matching efforts, which will be described in the next subsection.

4. RESEARCH METHOD, DATA SOURCES AND SAMPLE

Our sample contains 1015 applicants who have applied for a BTM (n=456) or a CTM (n=559) in 2009 under the precondition that it was registered ultimately within two years after the initial filing. The applicants were selected for participation in our study based on the availability of their e-mail addresses. The list of email addresses contained e-mail addresses from *pro se* filers and e-mail addresses which were provided by trademark attorneys, who registered the 2009 BTMs and CTMs on behalf of clients. In the Benelux it was Novagraaf, by far the largest firm providing trademark services, who provided nearly all e-mail addresses from 2009 BTM applicants in their client base, which explains the small overrepresentation of BTMs. If an email address related to more than one trademark, the trademark for which the respondent had to

answer the questions in the survey was selected randomly. This may imply a selection bias, since trademarks of frequent trademark filers may refer more or less frequently to innovation efforts.

The information in our dataset originates from three sources: the TIS-2 survey, databases of the respective trademark offices BOIP and OHIM and EPO's Espacenet database for information about patent application. TIS-2 contains several questions, ranging from structural characteristics of the respondent (e.g. firm size, sector) to the process of trademark registration (motives, timing, strategies of combining trademarks with other IPRs), to the reference of trademarks to various types of innovation. The TIS-2 survey was available online between July, 18th 2012 and January, 16th 2013. It was electronically linked with the IP offices' databases. This enabled the respondents to inspect details of their trademark filings while they were responding to the survey questions. Some of the variables from the trademark office databases were included in the dataset automatically by use of the electronic link, while other variables had to be retrieved manually from the databases with TMview. TMview is an online tool allowing to search for trademarks in databases of 35 trademark offices (see: http://www.tmview.europa.eu). Overall 8% of the 2009 trademark applicants filled out our survey.

To reconstruct patent histories of TIS-2 applicants we started off with entering the company name from the respective trademark records. After entering the company name in the EPO database in the "applicants" search box within the advanced search tab, it often led to low, unclear or no results. To ensure that no relevant patents were missed during the data collection, company names were shortened to check whether a part of the company name resulted in more hits. This could mean for example that legal extensions and abbreviations such as Ltd. or B.V. were left out. We filed the total number of registered patents of a TIS-2 respondent for different patent types: European patents (EP), World patents (WO) or national patents and aggregated

these numbers in our regression analyses. The data collection was done by a research team containing four members, randomized crosschecks were done over the obtained data by other team members at different time intervals. In this way – by checking each other regularly - a consistent system for noting errors or adjustments could be assessed to avoid repetitive errors.

Descriptive statistics of our sample can be found in Table 2. Verbal trademarks account for 51% of the sample, figurative trademarks for 25%, and combined trademarks for 23%. About 25% of the trademarks were filed with the help of trademark attorneys, which is substantially lower than the share of trademarks filed with attorneys in the research population (about 60%). More than half of the applicants (54%) had previous experience with trademark filing: 45% at a national trademark office, and 30% at OHIM.

The applicants had to indicate the sector of their core activities at the NACE two digit level. Most respondents are active in the service sector (47%), followed by the industry sector (37%), and 5% of the sample consists of firms operating in agriculture, forestry or fishing. These proportions, however, differ significantly from the 2009 distribution in the EU, in which 69% of the GDP was generated by service industries, 28% by manufacturers, and 2% by the tertiary sector. The difference may be caused by i) a sampling bias, ii) differences in the propensity to trademark innovations at the sector-level and iii) differences in innovation volumes at the sector-level. The differences found are caused primarily by a relatively large representation of large, manufacturing firms in our sample.

The vast majority (82%) of the sample are SMEs and mature firms (46%) serving other service industries or providing other industries with intermediate products (the *b2b* share is 65%); 72% are small firms with 50 employees or less, and 10.0% of the applicants represent medium-sized firms (51-250 employees). Large firms (251 employees or more) account for 13%

of the filings. This distribution fits with a finding by OHIM that in recent years the share of SMEs regarding trademarks has increased to over 90% (OHIM, 2011). The composition of the dataset enables us to compare small firms with large firms.

Only 3% of the trademarks are used for protecting brands in a local market, while 71% of the trademarks are used for the marketing of products and services in international markets. This seems to confirm Crass'(2013) view that the geographical distance between firm and customer may explain the firm-level propensity to apply for trademarks. Finally, our dataset contains many Dutch applicants, who have filed BTMs in 2009.

Insert Table 2 about here

Several aspects concerning the representativeness of the sample and the quality of the answers given by the respondents were checked. To study the representativeness of our sample the distribution of the sample trademarks over the Nice classes was compared with the population distribution. Figure 1 shows the trademark volumes in all Nice classes[2] based on the OHIM and BOIP databases (population expected frequency) and the sample dataset (sample observed frequency). Figure 1 shows a similar pattern for the observed sample frequencies and the expected population frequencies. However, a Chi-square test reveals a small, but significant difference (χ^2 (45) = 112.00, $p < 0.001$) caused by an underrepresentation of the Nice classes 16 (paper, cardboard and goods made from these materials) and 22 (ropes, string, nets, awnings, sacks and bags, etc.) and an over representation of class 42 (scientific and technological services), 44 (medical services) and 45 (legal services).

[2] The NICE classification covers 45 classes, of which classes 1-34 cover goods and classes 35-35 cover services (http://www.wipo.int/classifications/nice/en/).

We have also compared the number of verbal marks and figurative trademarks in our sample with the expected numbers from the population. In the BTM sub-sample the share of verbal and figurative trademarks is almost equal to the population: 46% of the sample consist of verbal marks (47% in the 2009 population) and about 54% of figurative trademarks (53% in the population). In the CTM sub-sample there are more verbal marks than figurative trademarks: 54% of the CTM sub-sample consists of verbal marks and 46% of figurative trademarks. Again the population and sample distribution reveal strong parallels. In the 2009 CTM population 58% are verbal marks and 42% figurative trademarks.

Insert Figure 1 about here

Additional validity checks were performed with the help of other IPR data sources. The patent applications of all respondents in the TIS-2 sample who claimed to have filed one or more patents along with the trademark were verified by tracing the patents back in the online patent register PATSTAT of the European Patent Office (EPO). PATSTAT contains more than 70 million patent applications from all over the world. For 22 of the 29 respondents (75%) in the BTM sample who claimed to have filed patents, we could confirm the registration of patent applications. For the 114 respondents in the CTM sample claiming to have filed one or more patents this percentage was even larger: 93 (80%). These rates would probably even have been higher if we would have had more data available than just the applicant's name. All patent applications of the respondents who rightfully claimed patent registration were examined. Based on the descriptions of both the trademark registered and the patent applications of the respondent the trademarks were matched to single patents if possible. In the BTM sample about 65% of the

trademarks for which the application of patents could be confirmed could be matched to a single patent application. These trademark-patent pairs refer predominantly to SME's. The remaining 35% consist of large firms with large and continuously expanding patent stocks. For these firms it is impossible to match a trademark and a single patent application. The number of large firms in the CTM sample is higher and therefore also the share of trademarks which cannot be matched to a single patent. About 50% of the respondents in the CTM sample with confirmed patent applications consist of firms for which the trademark registered cannot be matched to a single patent application. Remarkably both in the BTM and CTM samples most of the matched patent applications are European patent applications instead of national patent applications. This is an indication that the innovations involved should be considered to have a significant value because the costs involved in a European patent application compared to an application at a national patent office are much higher.

5. METHODS AND VARIABLES DEFINITION

We focus on the three types of innovation for which we find the highest shares of respondents claiming a relation with their trademarks (see Figure 2), namely product, process and service innovation. Specifically, the survey question asked trademark owners to indicate whether the trademark at hand referred to a 'new or significantly improved product', 'a new way of manufacturing products or delivery of services' or 'new or significantly improved service' respectively.

Insert Figure 2 about here

Our dependent variable is a dummy taking the value of 1 whenever the respondent has claimed that the trademark at hand referred to a new product, service or process and the value of 0 in all other instances. We also consider as dependent variable whether the trademark is referring to radical innovation instead of incremental one. In this case, we consider the sub-sample of the trademarks that do refer to innovation and define therein a dummy signaling radicalness which takes the value 1, when the respondent claims the underlying innovation to be 'new to the world' and the value 0 when this is not the case, meaning that the innovation is either only new to the firm, market or industry.

Our explanatory variables include several variables already proposed in previous studies as discussed in our short literature review in section 2. Most importantly, we make a distinction between explanatory variables that we can extract from trademark records directly and other variables that instead stem from our survey and from matching trademark and patent data. All variables are explained in Table 3 and descriptive statistics are reported. The variables that can be easily extracted from the trademark record itself include: the trademark system (CTM or BTM), the type of trademark (word, figurative or combined), the trademark breadth in terms of Nice classes covered[3] and the involvement of trademark attorneys. The other variables have been selected based on the focus of this paper and include variables capturing: (i) the volume of patents owned by the trademark applicant, (ii) the joint use of the focal trademark with at least one patent, and (iii) the applicant's trademark filing strategy as conceptualized by Sandner (2009) and Block *et al.* (2014).

[3] Note that pricing schemes at trademark offices are such that registration in 3 Nice classes is almost as costly as registration in one class only. This discount explains why the number of Nice classes only makes sense when larger than 3.

As for the last variable, trademark filing strategies can only be defined for firms already possessing at least one trademark. We then use as reference category all first-time applicants. If an applicant already owned trademarks, we could relate the new trademark to the existing ones by checking its content similarity. If the new trademark has a very high level of similarity to at least one existing trademark by the same applicant, the new application is characterized as brand-modernizing. If the new trademark has a reasonable level of similarity (for instance the same word root), then it is classified as a brand-extension strategy. If instead the similarity is low, then the application qualifies as brand-creation strategy.

While we use similar labels, our classification differs from the one of Sandner (2009). In the first place, we consider also figurative trademarks, while the automated procedure by Sandner (2009) only treats word marks. In the second place, at this stage we leave brand-hedging strategies aside and do not distinguish between brand creation with multiple filings on the same date and brand creation with separate filings. Finally, we are not using the information on market coverage, since we feel that a change in the NICE classes covered by the applicant might also be related to changes in the product diversification of the applicants over time.

In terms of control variables, we have information on firm size, whether the applicant is a start-up and the main market/sector (b2c, international, service industries) where the respondent is active have been added to take account of the findings from the literature that an applicant's resources and capabilities matters to explain the use of IPR and that the use of trademarks varies substantially across sectors and markets.

Given the nature of the dependent variable we rely on binary logistic regression models. We estimate the effect of our variables of interest on the probability that a trademark would refer to innovation. To gauge the goodness of fit of the models we look at different indicators,

including the Nagelkerke R square measure and the prediction rate from the classification table underlying the estimated model (Hosmer *et al*, 2013).

6. DATA ANALYSIS

In the first place, we consider the whole sample of observations and focus on the first hypothesis on the role of combining trademarks with patents. If the hypothesis is confirmed, in line with earlier findings from Flikkema *et al.* (2014), then this warrants a separation of the sample into trademarks jointly used with patents and trademarks not jointly used with patents.

Table 4 shows the estimates for the models predicting the reference to (radical) innovation. When we consider only structural trademark and applicant characteristics (first model estimated), we find that a significant relation with the reference to innovation only for trademarks filed by startups (more likely to refer to innovation) and for trademarks filed by service firms (less likely to refer to innovation). Once we insert our theoretical variables of interest, namely the combination with patent applications (H1) and the distinctive branding strategies (H3 and H4), the model estimations offer more interesting results. The results for innovation in general (both radical and incremental) reveal that the joint use of patents in the same project which concerns the focal trademark registration strongly increases the likelihood of that trademark referring to innovation, as expected. Interestingly though, the trademark filing strategies have also explanatory power, as trademarks filed for brand creation or brand extension have a higher probability to refer to innovation than trademarks filed for the first time and unrelated to previously owned trademarks.

Insert Table 4 about here

Table 4 also reports the estimates for the models predicting the odds that the innovation is radical. The combination with patents is again strongly positively related to the chance of the trademarks being associated to a radical innovation. Instead, trademark filing strategies have no role in discriminating trademarks referring to radical instead of incremental innovation. Whether the firm is a startup and whether it is a small firm, two related properties, significantly increase the chance that a given trademark signals radical innovation. This probably hints to the idea that larger and established firm might use trademarks more as part of general marketing and branding strategies where signaling innovation is just one of the many motives of trademark registration. For small start-ups, trademark registration might instead be related more closely to signaling what differentiates them in the market, often some form of innovation. An alternative explanation of this result could also be that startups tend to overestimate the newness of their offerings.

Remarkably, the breadth of trademark, used by some studies, including Sandner and Block (2011), to capture the value of trademarks, and also by Melnyk *et al.* (2014) does not show any significant relation with the chance of a trademarked innovation being radical.

Given the overwhelming role of patents in flagging trademarks referring to innovation, we proceed to investigate the two sub-samples of trademarks which are indeed combined with patents and of trademarks for which respondents did not indicate they also applied for a patent.

Insert Table 5 about here

Table 5 shows the model estimations for the first sub-sample. It should be clear that the majority of this group of trademarks does indeed refer to innovation, namely 81,2%, while 31,2% refers to new-to-world innovation. We expect then that the models predicting innovation

will be less interesting than the ones predicting the reference to radical innovation. We show the results for both. Indeed, of all the variables we consider only whether the applicant is a start-up helps to discriminate even further those trademarks that are combined with a patent which refer to innovation. Trademark filing strategies, information on the relative importance of trademark and patents for the applicant and the volume of recent patents do not appear to be significantly related to the reference to innovation. Instead, when we consider the question of distinguishing radical vs incremental innovation, we find several significant effects. We report two different model specifications with and without the start-up dummy, due to possible collinearity issues. Trademarks filed for brand extension and to less extent also for brand creation seem to be more likely to refer to radical patented innovation. The use of IP attorney appears to have a negative effect on the same dependent variable: this seems to suggest that when attorneys are involved, trademarks are filed for other motives than flagging innovation. Finally, applicants with a higher relative volume of trademarks vs patents seem also to have lower odds to refer to radical innovation. This result might indicate applicants who are well aware of the benefits of using trademarks but possibly base their competitive strategy less innovation and more on other forms of differentiation.

Finally, from the results reported in Table 6 we can learn that information about trademark filing strategies for brand creation and brand extending purposes is clearly helpful to distinguish trademarks referring to unpatented innovations from trademarks that are not related to innovation. This is an important first step towards identifying innovations from trademark data when patent applications are not involved, although the predictive power of the explanatory variables is limited.

Insert Table 6 about here

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7. CONCLUSIONS, LIMITATIONS, POLICY IMPLICATIONS AND A RESEARCH AGENDA

7.1 Conclusions

Based on our large scale case-level study of 2009 BTM and CTM registrations we can conclude that distinctive trademark filing strategies, engagement in patent application and trademark filing by start-ups in manufacturing industries predict the reference of trademarks to innovation. In general, getting more insight into innovation by using trademarks, requires both combining trademark data with patent data and exploiting the full information on whole trademark portfolios. First, our study revealed that innovation researchers may benefit substantially from matching trademark data with patent data. In this case, we could match trademark applications and patents related to the same project, but information on patent history already provide clues on the trademark-innovation linkage. Second, we find that trademark filing strategies for brand creation and extension purposes are a predictor of both patented and unpatented innovations. The latter can be considered as an important contribution, since about 80% of the innovation related trademarks refers to unpatented innovations. Third, we did not find strong effects of the involvement of attorneys in the trademark filing process and neither did we find differences between the CTM and BTM system, and for the trademark breadth. We did find that trademarks filed by start-ups frequently refer to innovations, both patented and unpatented. Finally, the role of industry heterogeneity is confirmed in our study. We found differences between trademarks filed by applicants from service industries and manufacturing. However, we did not find differences between *b2b* and *b2c* markets as hypothesized by Malmberg (2005). Overall we can conclude that the value of trademark data for innovation studies can be improved substantially by

matching trademark data with patent data from other sources and by using information from trademark portfolios of single applicants instead of single trademark records.

7.2 Limitations

We should mention at least three limitations of our study. First, although we did some validation of the reported data, in particular in cases of reported bundling with patents, we have not validated the self-reported reference of BTMs and CTMs to innovation. Second, even though our data now cover multiple countries, they mainly relate to the European context. Whether these results hold in non-European settings remains to be studied. Lastly, even though we did find significant effects, the overall explanatory power of the models remains limited. Further testing with even larger samples could help checking the validity of our results.

7.3 A research agenda

Based on the results of our study, we propose three main avenues for future research. Research into i) the possibilities of matching trademark data with other IPR databases, R&D data and firm performance data, ii) cases for improving our in depth understanding of the trademark innovation linkage and IP strategies with trademarks and iii) the role of trademarks for start-ups versus mature firms.

The potential of matching trademark data with patent data has become apparent in our study. There is an evident need for developing heuristics and algorithms to match trademark data with other IPR data, for example design rights and breeders rights, and economic data. Note that OHIM, the OECD and the European Patent Office (EPO) already have some experience with matching trademark and patent data (OHIM, 2013; Thoma and Torrisi, 2007) and in the US are Lybbert, Zolas and Bhattacharyya (2013) working on an algorithm for matching trademark data

and economic activity data. Such combinations of data will help us to get a better view on how to measure radical and incremental innovation and, eventually, will help to clarify the performance consequences of different innovation types and IP strategies.

With case studies we can probably learn much more about the motivation of applicants to trademark innovations – including its timing-, trademark breadth considerations as well as, the considerations for involving attorneys and the reasons for preferring a certain trademark system over others. With the exception of Malmberg' s (2005) study, no in depth case studies are known, although economists can probably also learn from case studies provided by lawyers practicing IP law and academics from law schools, or from "case law". Our findings in particular raise questions about why and how companies decide to combine different IPRs and when they decide to register trademarks for appropriation purposes standalone. Since many applicants have a long history of trademarking and own large trademark portfolios, portfolio analysis and in particular changes in it, may contain information which is also helpful for predicting the trademark reference to innovation. For example information about trademark opposition (Sandner and Block, 2011) or prolongation (Melnyk *et al.*, 2013) as well as information about trademark applicants starting at national systems and 'jumping' to international registrations may be beneficial for understanding the trademark innovation linkage. Portfolio analysis may reveal trademark patterns and discontinuities, and also new information about branding strategies. All these investigations will require both development of new theories connecting more closely innovation and marketing strategies of companies, and empirical efforts aimed at constructing longitudinal datasets capturing trademark strategies.

Finally, start-ups seem to have distinctive trademark filing strategies since trademarks may signal their very appearance in the market. It seems promising to investigate whether start-

ups in different types of markets use trademarks with specific motives and whether start-ups, given their resources-constraints, have particular reasons to complement or substitute trademarks with patents in their IP strategy.

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TABLES

TABLE 1. Studies exploring the relationship between trademarks and innovation activity.

Source	Citation	Nation coverage	Innovation proxy	IP rights covered	Proxy of IP usage	Sector coverage	Key results
CIS survey	Schmoch (2003)	Germany	sales share of new products and services	trademarks, patents	firm-level usage (y/n) of patents and trademarks	manufacturing and services industries	Significant correlation between innovation and trademark use for KIBS.
CIS III survey	Mendonça *et al.* (2004)	17 EU member states	product innovation	trademarks, patents	firm-level usage (y/n) of patents and trademarks	nation aggregated data	Innovative firms consistently use more trademarks and patents.
MIBS survey	Jensen and Webster (2009)	Australia	product, process, organizational and marketing innovation	trademarks, patents, design rights	firm-level trademark and patent activity	manufacturing and service industries	Product innovation is correlated with patents and trademarks, as well as R&D, but not with design rights. Process and Organizational innovation show nil or negative correlations with IP activity. Marketing innovation only slightly positively related to TM activity.
NSF, USPTO	Daizadeh (2009)	USA	R&D spend	trademarks, patents	number of IP rights applied for and granted/registered	nation aggregated data	The correlation between R&D spend and the number of trademark filings at the national level is stronger than the correlation with the number of patent applications.
TIS-1 survey	Flikkema *et al.* (2010)	Belgium, Netherlands, Luxembourg	product, process, service, organizational and marketing innovation	BTMs, patents, design rights, growers rights, copy rights	case-level bundling of the various IP rights with the trademarks studied	manufacturing and services industries	60% of all BTMs refers to innovative activity, predominantly to product, service delivery and marketing innovation.
Orbis, PATSTAT, OHIM, INPI	Millot (2012)	France	product, process, organizational and marketing innovation	trademarks, patents	firm-level usage (y/n) of patents and trademarks	manufacturing and services industries	Product and marketing innovations are determinants of trademark activity, while process innovation and organisational innovation are not.
CIS IV and KIBS survey	Götsch and Hipp (2012)	Germany	sales share of new products and services	trademarks, patents, design rights, copy rights	firm-level usage (y/n) of IP rights	low tech and high tech manufacturing, KIS, KIBS and other service industries	Significant correlation between innovation and trademark use in high-tech manufacturing and KIBS.
TIS-2 survey, OHIM, BOIP	"*the current study*"	EU member states	product, process, service, organizational and marketing innovation	CTMs, BTMs, patents, design rights, growers rights, copy rights and informal protection measures: trade secrets, lead-time advantage, confidentiality agreements.	case-level bundling of the various IP rights with the trademarks studied	manufacturing and services industries	CTMs refer more frequently to innovative activity than BTMs, in particular to product innovation. Both trademark and applicant characteristics predict the trademark reference to incremental and radical innovation. Matching trademark data with other IP data sources is highly beneficial.

TABLE 2. Sample demographics.

Variable	Categories	*n*	Sample share
1. Trademark system	BTM	456	45%
	CTM	559	55%
2. Trademark type	Verbal	513	51%
	Figurative	255	25%
	Combined	231	23%
	Unknown	16	2%
3. Trademark attorney involved	CTMs "yes"	122	22%
	BTMs "yes"	110	24%
	CTMs "no"	437	78%
	BTMs "no"	346	76%
4. Trademark use	first-time applicants	468	46%
	frequent users	547	54%
5. Trademark object	A product	156	17%
	A service	74	8%
	An offer containing both product(s) and service(s)	66	7%
	A range, category, or line of products	240	26%
	A range, category, or line of services	54	6%
	A range, category, or line of products and services	37	4%
	All products and/or services of my company	283	31%
6. Industry	Services	479	47%
	Manufacturing	379	37%
	Agriculture, forestry and fishing	48	5%
	Extraction of minerals	4	0%
	Not-for-profit	105	10%
7. Geographic focus	Local	23	3%
	Regional	22	2%
	National	190	21%
	International	645	71%
	Not applicable	30	3%
8. Market orientation[1]	B2B	660	65%
	B2C	424	42%
	B2NP	119	12%
9. Firm maturity	Future start-ups	32	3%
	Start-ups	340	33%
	Mature firms	465	46%
	Not applicable	178	18%
10. Firm size	1 "a one man business"	196	19%
	2 to 4	228	22%
	5 to 9	132	13%
	10 to 49	184	18%
	50 to 249	97	10%
	250 to 499	24	2%
	≥ 500	107	11%
	not applicable	47	5%
11. Country of origin[2]	German	205	20%
	English	126	12%
	Spanish	55	5%
	French	110	11%
	Italian	93	9%
	Dutch	426	42%
	CTMs	24	2%
	BTMs	402	40%

[1] respondents could fill out multiple categories here.
[2] respondents actually filled out their preferred language

TABLE 3. Descriptive statistics of the variables used in the regressions.

Variable name	Variable definition	valid N	Mean	Std. Deviation	Minimum	Maximum
Innovation	Dummy indicating whether the trademark refers to a product, service or product innovation.	1015	,573	,495	0	1
Radical innovation	Dummy indicating whether the trademark refers to a *new-to-world* product, service or product innovation.	1015	,078	,268	0	1
CTM	CTM=1 if Community Trademark, CTM=0 if Benelux Trademark	1015	,551	,498	0	1
word mark	Word mark vs combined mark	999	,514	,500	0	1
figurative mark	Figurative mark vs combined mark	999	,255	,436	0	1
NICE breadth (>3)	Dummy indicating whether the trademark is filed in more than 3 NICE classes	999	,155	,362	0	1
Use of IP attorney	Dummy indicating of the applicant used the services of an IP attorney	1015	,229	,420	0	1
startup	Dummy indicating whether the company is a start-up instead of a mature firm	837	,406	,491	0	1
internationally oriented firm	Dummy indicating whether the firm is active internationally	910	,709	,455	0	1
firm size	Categorical variable (see Table 2))	1015	3,486	2,094	1	8
services	Dummy indicating whether the firm's main sector is in services (vs Agriculture, Mining and Industry)	910	,526	,500	0	1
B2C	Dummy indicating whether the firm is mostly targeting end consumers instead of business ones.	910	,466	,499	0	1
Combined with patent	Dummy indicating whether the trademark filing is being combined with a patent application.	1015	,136	,343	0	1
Brand creating	Dummy for brand creating vs first trademark	1015	,218	,413	0	1
Brand extension	Dummy for brand extension vs first trademark	1015	,146	,353	0	1
Brand modernizing	Dummy for brand modernizing vs first trademark	1015	,034	,183	0	1
TM/patent ratio	Total nr of TMs/(Total nr of patents+1)	1015	3,866	14	0	276

Patent volume 3 years	Total nr of patents registered in the last 3 years	1015	12,955	134	0	3486
Valid N (listwise)		823				

TABLE 4. Binary logistic regression estimates of the models predicting the reference to innovation for the whole sample. Bold coefficients indicate an effect significant at least at 5% (p-value <0.05).

	DV: Innovation		DV: Innovation		DV: Radical innovation	
	coeff	p-value	coeff	p-value	coeff	p-value
CTM	,197	,344	,200	,346	,172	,677
word mark	,258	,240	,158	,485	-,083	,860
figurative mark	,089	,762	,091	,762	-,784	,213
NICE breadth (>3)	-,130	,521	-,180	,383	,170	,700
Use of IP attorney	,023	,898	-,053	,776	-,419	,311
startup	**,349**	**,034**	**,357**	**,037**	**,999**	**,006**
internationally oriented firm	-,130	,456	-,247	,166	,629	,120
firm size	,045	,297	-,012	,793	**-,212**	**,041**
services	**-,424**	**,007**	-,307	,055	-,138	,671
B2C	-,032	,824	-,049	,738	-,347	,253
Combined with patent			**1,045**	**,000**	**2,194**	**,000**
Brand creating			**,492**	**,014**	-,403	,338
Brand extension			**,527**	**,029**	,014	,977
Brand modernizing			-,402	,381	,087	,930
n	823		823		488	
R2 Nagelkerke	0,029		,076		,286	
Predicted correctly	60%		60,5%		86,5%	

TABLE 5. Binary logistic regression estimates of the models predicting the trademark reference to innovation when there is joint use patent-trademark. Bold coefficients indicate an effect significant at least at 5% (p-value <0.05).

	DV: Innovation		DV: Innovation		DV: Radical innovation		DV: Radical innovation	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
CTM	-,247	,782	-,391	,670	,051	,945	,145	,839
word mark	,824	,438	1,234	,292	-,336	,757	-,563	,600
figurative mark	-,122	,918	,370	,774	-1,306	,283	-1,335	,263
NICE breadth (>3)	-,246	,726	-,210	,778	1,492	,125	,874	,280
Use of IP attorney	-,291	,588	-,027	,963	**-2,327**	**,006**	**-2,061**	**,007**
startup	**1,359**	**,031**	**1,443**	**,024**	,000	1,000		
internationally oriented firm	-1,048	,351	-1,181	,314	1,286	,174	1,212	,189
firm size	,208	,154	,126	,455	-,184	,249	-,191	,191
services	-,443	,448	-,404	,500	-,313	,613	-,079	,892
B2C	-,431	,393	-,427	,421	-,402	,463	-,465	,375
Brand creating			-,250	,713	1,063	,188	*1,278*	*,088*
Brand extension			-,125	,874	**2,618**	**,019**	**2,279**	**,023**
Brand modernizing			-,275	,849	1,515	,262	,632	,600
TM/patent ratio			,401	,208	*-,225*	*,056*	**-,257**	**,042**
patent volume 3 years			,016	,346	-,076	,193	-,071	,227
n	123		123		98		107	
R2 Nagelkerke	0,15		,243		,460		0,451	
Predicted correctly	81%		80,5%		78,6%		80,4	

TABLE 6. Binary logistic regression estimates of the models predicting the trademark reference to unpatented innovations. Bold coefficients indicate an effect significant at least at 5% (p-value <0.05).

	DV: Innovation		DV: Innovation		DV: Radical innovation	
	coeff	p-value	coeff	p-value	coeff	p-value
CTM	,199	,369	,240	,283	,186	,737
word mark	,162	,480	,073	,754	,220	,708
figurative mark	,118	,706	,144	,648	-,093	,909
NICE breadth (>3)	-,152	,482	-,195	,374	,097	,871
Use of IP attorney	,058	,771	,023	,911	,341	,506
startup	,174	,317	,263	,144	**1,399**	**,006**
internationally oriented firm	-,170	,349	-,216	,243	,201	,669
firm size	,000	,991	-,036	,452	-,208	,203
services	**-,329**	**,049**	*-,297*	*,078*	-,331	,431
B2C	-,012	,939	-,022	,885	-,577	,158
Brand creating			**,524**	**,013**	-,633	,296
Brand extension			**,532**	**,040**	-1,129	,298
Brand modernizing			-,642	,221	-18,655	,999
n	700		700		390	
R2 Nagelkerke	0,015		,036		,159	
Predicted correctly	57%		56%		92,1%	

FIGURES

FIGURE 1 Sample and population distribution over the NICE classes.

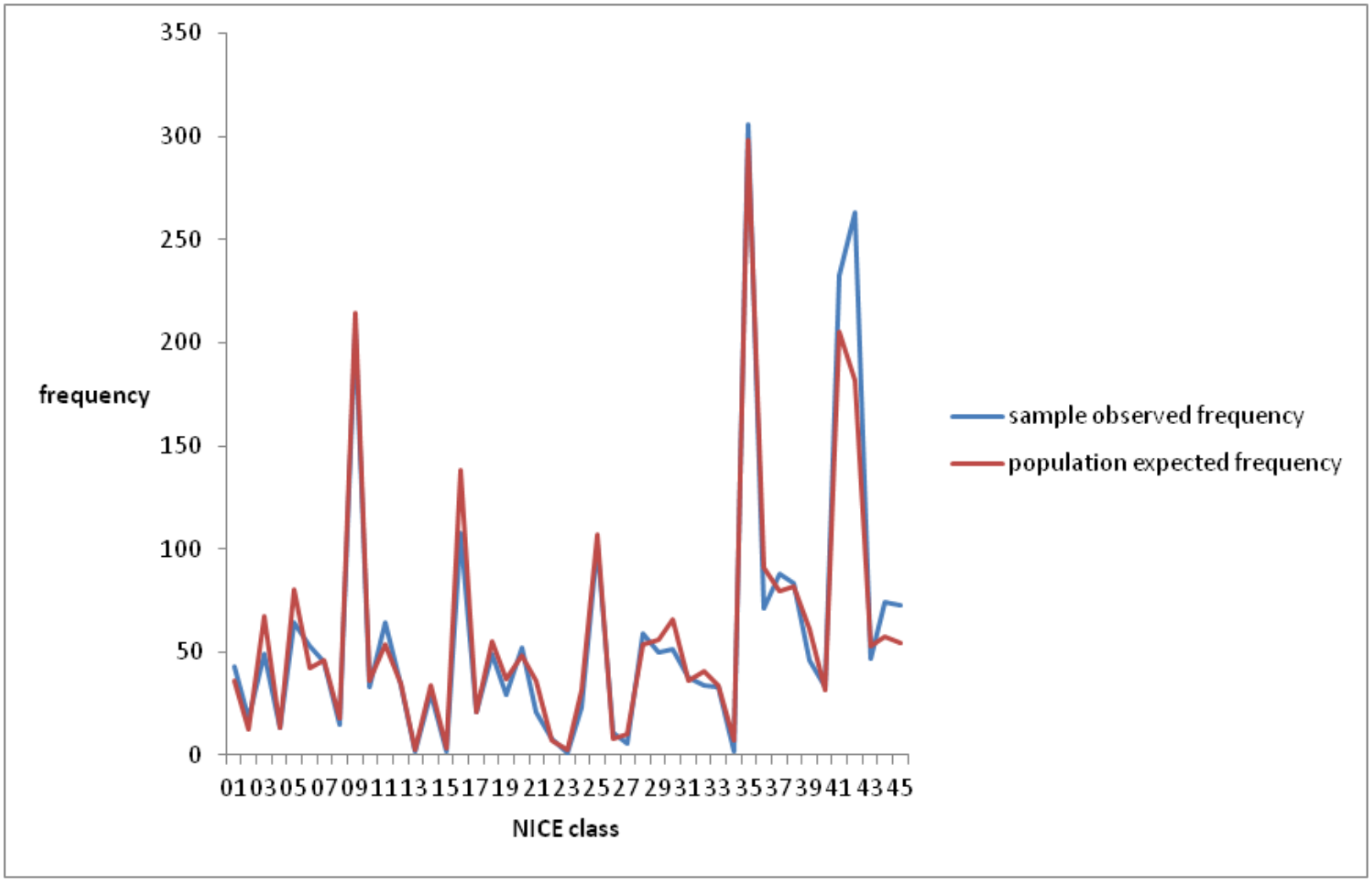

FIGURE 2 Trademark reference to innovation activity for BTMs and CTMs.