Measurement of Innovation Activities in the Knowledge Intensive Services Industry: A Trademark Approach

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Innovation measurement in the knowledge intensive services industry is very complex due to the lack of adequate innovation indicators. A rather new empirical approach involves the analysis of trademarks for such measurement. This paper aims to explore the use and relevance of trademarks for service firms in depth. The results of two independent empirical studies show that a trademark can be used as an innovation indicator, at least for knowledge intensive (business) services, and mainly for product innovations. The results also show which firm-inside and environmental features of knowledge intensive business services explain the use of trademarks as an intellectual property protection measure.

1. Introduction

The importance of services for the economy has constantly risen over the last several decades (OECD, 2005b; Arundel et al., 2007). Today, the services sector accounts for a large part of value added and total employment in nearly all developed countries. Foresight studies mention that the importance of services will even continue to increase in the future. This is especially true for the so-called knowledge intensive services (KIS) and a smaller segment, the knowledge intensive business services (KIBS), which in some cases are even more related to information and knowledge, and are highly innovative (Toivonen/Tuominen, 2009; Miles, 2008; Gallouj, 2002; Miles, 2000). However, innovation measurement in services is in general very complex because of the lack of adequate innovation indicators. A rather new empirical approach is measurement via the analysis of trademarks (Schmoch/Gauch, 2009). This paper explores how trademarks could be established as an additional indicator for service innovation. For this purpose we conduct two empirical investigations based on an understanding of knowledge intensive (business) services, respecting their importance for the whole economy.

The paper is organised as follows. In Section 2, we describe service innovations and the difficulties involved with capturing and measuring a service innovation. By doing so, we show that there is a need for additional innovation indicators in the KIS (and KIBS) industry.

In Section 3, which presents the empirical methodology, we first develop four research hypotheses based on the related literature. We use data from the German

part of the Community Innovation Survey to explore whether there is a correlation between trademark registration and innovation success. We also investigate which type(s) of innovation (product, process, organisation, marketing) can be measured with trademark(s) as an indicator. In a second step, we conduct a survey in the field of knowledge intensive business services in order to deepen the understanding of the connections between innovation and trademark protection. We investigate which firm-inside and environmental characteristics of KIBS explain the use of trademarks as an intellectual property rights (IPR) protection measure.

In the conclusion (Section 4), the relevance of trademarks as an innovation indicator for KIBS is discussed based on the outcomes of the two independent empirical studies. By doing so, researchers as well as policy makers and management can learn about the possibilities and limitations of trademarks as a new innovation indicator in order to better describe, understand, and benchmark innovation activities in the KIBS industry.

2. Knowledge Intensive Services and Innovation

There exist several partly identical, partly different definitions of KIS and KIBS[1]. Here, we refer to Miles, who claims that KIBS are services that provide knowledge intensive inputs to the business processes of other organisations. Examples of KIBS sectors are, among others: computer services; research and development services; legal, accountancy, and management services; architecture, engineering, and technical services; advertising; and market research (Miles, 2005, 39). Firms providing KIS and KIBS combine knowledge from different sources and distribute that knowledge. They are highly innovative and also facilitate innovations in other economic sectors (Hipp/Grupp, 2005, 518). Therefore, KIS and KIBS are an important part of the economy and it is worth exploring their role in the innovation process in depth.

2.1. Innovations in Knowledge Intensive Services

Following Hipp and Grupp (2005), innovation in services is different from innovation in manufacturing; therefore, to the two must be handled and measured in different ways. Service innovation results from the creation of new combinations of knowledge (Miles, 2005, 39). The core competence of KIBS resides in their capability to combine – in a new unique body of knowledge – codified scientific and technical knowledge, with tacit knowledge based on extensive experience. In such a way they help other firms to deal with problems for which external sources of knowledge are required (Amara et al., 2009, 407; Miles, 2005, 39).

[1] More definition of KI(B)S can be found in, e.g.: Muller/Doloreux, 2009; Amara et al., 2009; Leiponen, 2006; Muller/Zenker, 2001; Den Hertog, 2000.

Service innovation can be technological innovation, but it does not necessarily have to be. Following the synthesis approach[2], which combines the assimilation and demarcation approaches, we classify four forms of innovation according to the Oslo Manual (OECD, 2005a): Product, Process, Marketing, and Organisational Innovation. All can occur in both the manufacturing and services industries.

In this context, a service innovation is a new or significantly changed service concept, client interaction channel, service delivery, or technological concept that individually, but more likely in combination, leads to one or more new service functions. This innovation provides benefit to the organisation developing them by changing the service or goods offered in the market. Consequently, the benefit results from the added value that the service innovation provides the customers. The innovation must be new not only to the firm but also in a broader context, so it must involve some general elements which can be transferred to other new situations. Therefore, a service innovation requires structurally new technological, organisational, or human capabilities of the service organisation (van Ark et al., 2003; Sundbo, 1997).

Innovation in services, as it was described in this section, is more multidimensional than innovation in the manufacturing industries. KIS and KIBS innovations are often not generated in special departments (Kanerva et al., 2006), but during daily work in cooperation with customers or in time-restricted project groups. In many cases, innovation is not the consequence of a precise research process (Blind et al., 2003, 19). In this context, human capital is an important factor for the success of service innovation. However, because of the multiple forms in which an innovation in services might occur, there are some difficulties in measuring it.

2.2. Measurement Challenges of Knowledge Intensive Service Innovations

As it was stated, service enterprises are innovative. However, due to the multiple innovation forms described in Section 2.1, there is no exact definition of what a service innovation is, and because of this fact it is difficult to systematically measure innovations in the services sector (Hipp/Grupp, 2005). This is connected with a limited applicability of traditional innovation indicators such as expenditures for research and development (R&D) activities or patent counts.

Indicators often used in the manufacturing industries are frequently connected with R&D activities. In light of the linear innovation model, R&D could be established as the source of innovation, supported by a relatively simply constructed measurement concept. The Frascati manual standardised and harmonised this R&D-based approach (OECD, 2002). Although it is acknowledged that technological change is not exclusively based on R&D activities, this monetary input indicator is often – because of the lack of alternatives – employed as the single variable for measuring innovation activities, allowing statistical bias to influence the analysis. The R&D measurement concept has proven especially disadvantageous for the service sector. As the sector's share in the official R&D statistics is small, it has been concluded that the ser-

[2] Further reading relating to the synthesis, assimilation, and demarcation approach can be found in e.g.: Drejer, 2004; Sundbo/Gallouj, 2000; Gallouj/Weinstein, 1997.

vice sector is hardly innovative at all, without considering the specific characteristics of service innovation processes (Hipp/Grupp, 2005, 524). Therefore, concentrating on R&D expenditures or R&D personal intensity is not an appropriate approach.

Another non-technological component of innovation activity can be derived from intangibility. The innovation process does not necessarily aim to acquire or generate technical know-how. Technologies and related processes (e.g. patent applications) are not the centre of the innovation process in services. The literature indicates that patent protection and the theoretical concept of patent competition in the service sector are only of minor importance. For instance, patents are not suitable as indicator because many service innovations do not achieve the requirements to get patent protection (Coombs/Miles, 2000). In almost every empirical study on service innovation, the protection of innovation activities turns out to be extremely difficult whilst the majority of innovations in the manufacturing sector are easily protected by some kind of IPR (Blind et al., 2003, 26; Hipp/Grupp, 2005, 525).

One can conclude that new indicators are needed to develop both an overview and more detailed insight on the innovation activities of the services sector. A development of fitting indicators to measure service innovation would be useful. A promising new indicator to fill this existing research gap involves the examination of trademark registrations at the national and international patent and trademark authorities (Schmoch/Gauch, 2009). Therefore, we investigate in the following Section 3 whether it is possible to make conclusions regarding a relationship between trademark registration and innovation success.

3. Trademarks as an Additional Innovation Indicator for Knowledge Intensive Services

There is a simple, but significant, advantage of trademarks for their use as an innovation indicator: All service innovations can be protected with trademarks. A trademark is a legally protected symbol which is used to clearly distinguish the products and services of one company from those of other firms, which is described as the distinction function of a trademark (Greenhalgh/Rogers, 2007, 4). The second function is a protection function, which means that the trademark serves as a protection of IP and gives monopoly rights by prohibiting other companies from operating with similar or identical trademarks in similar or identical markets (Rammer, 2007).

Trademarks can be registered at the national, regional, or international level.[3] The available registration statistics of trademarks includes dealer's brands, trademarks, and service marks. Not every new trademark is necessarily connected to a new, innovative product; however, Mendonca et al. (2004) state that applications for products that have no substantive difference from former ones represent only a minority in the overall demand for new trademarks. Further, it can be assumed that trade-

[3] A regional authority is, for example, the Office for Harmonization in the Internal Market (OHIM), which grants community trademarks for protection in the member states of the European Union. Worldwide protection is available at the World Intellectual Property Organization (WIPO), at least for signing states of the Madrid Protocol.

marks are registered just shortly before the launch of the product or service in the market, indicating a later phase as a patent in the innovation process. It can also be assumed that products and services related to brands will indeed be launched, and that there will not be any significant selection process which occurs during patent registration and granting (Hipp/Grupp, 2005, 526).

In a survey on IPR in the service sector, trademarks were ranked highest in regards to the importance of various protection instruments (Blind et al., 2003, 17). On the other hand, even services containing no or only low levels of innovation can be brand protected, which perhaps limits the statistical value of a trademark as an innovation indicator. Also, trademarks are often not directly, and only indirectly, linked to an innovation (Blind et al., 2003, 9). Increasing visibility or a reflection of competitive strategies might be the main motivation to register a trademark for the service firm. According to these limitations, the suitability of trademarks must be assessed empirically before trademark statistics can be used as reliable innovation indicators (Livesey/Moultrie, 2008, 25).

3.1. Literature Review and Hypotheses Generation

Building on theory and the work of service innovation scholars, several research hypotheses can be developed. These hypotheses are then empirically tested in Sections 3.2 and 3.3. We first concentrate on service firms, which are knowledge-driven, and examine their innovation capabilities. As was documented in Section 2, KIBS have been recognised as innovators and carriers of change (Muller/Doloreux, 2009, 69). Many researchers have come to the conclusion that KIS and KIBS firms are related to different forms of innovation listed in the Oslo Manual (Muller/Doloreux, 2009; Abreu et al., 2007; Camacho/Rodriguez, 2005; Muller/Zenker, 2001; Sundbo/Gallouj, 2000; Den Hertog, 2000). Hence, we develop the first hypothesis we would like to test.

H1*: KIS and KIBS firms are more innovative than other kinds of firms.*

Dealing with the question of whether trademarking could signal innovative activity, prior investigations found a correlation between trademarks and productivity (Greenhalgh/Rogers, 2005) or stock market value (Greenhalgh/Rogers, 2007) as well as between trademarks and innovation (Rammer, 2003; Schmoch, 2003; Rammer, 2007; Amara et al., 2008). In a next step, other researchers tried to use trademarks as an indicator of innovation (Gatrell/Ceh, 2003; Mendonca et al., 2004; Gauch/Schmoch, 2005; Malmberg, 2005; Millot, 2009; Schmoch/Gauch, 2009). For instance, Rammer (2003) found that companies introducing services in the market generally use some kind of protection measure. Thereby, trademarks are used primarily to differentiate a firm's own services from potentially competing services.

In the services sector, when patent protection is not possible, trademarks seem to have a positive impact on innovation success (Rammer, 2007, 67). Päällysaho and Kuusisto (2008) confirm that highly innovative KIBS use more trademarks than less innovative firms. Aaker (2007) states that trademark protected brands allow ownership of innovations because a trademark adds credibly and legitimacy, enhances visibility, and helps communicate facts. A competitor may be able to replicate the offering, but if the innovation is branded, the challenger will need to overcome the power

of a trademark protected brand (Aaker, 2007, 11). In conclusion, we derive the second hypothesis.

***H2**: Innovative firms use trademarks more often than other firms.*

Based on what can be protected through a trademark, one could conclude that trademarks are a very market-based tool. Companies award brands and trademarks to newly introduced products in order to distinguish them from the products of competitors. Firms hope that if they have an innovative product which is recognised by their customers and has a good reputation, they can carry this effect on to other products and to the company as a whole. Consequently, trademarks are right at the threshold between innovation protection and marketing strategy (Rammer, 2003, 5). Marketing strategy and brand strategy are closely related, so trademarks could also provide information on marketing innovation (Millot, 2009, 8). On the other hand, it does not seem to make much sense to protect back office activities such as process innovations, which are not directly recognised by the market. However, it seems more likely that a firm will protect new products or marketing innovations by using trademarks. Thus, we come to the third hypothesis.

***H3**: Trademarks serve as an indicator of product and marketing innovations, but do not signal process or organisational innovations.*

When exploring which firms use trademarks to protect their IP, we must look at the different characteristics of the firm and their surroundings and test if there are special features in the following areas that influence trademark activities:

Distribution markets

Studies show that there is a relationship between high levels of internationalisation and high levels of innovation activities (Muller/Doloreux, 2009, 69), which in turn could be protected by trademarks. Therefore, international firms with widespread distribution markets use more trademarks than regional companies.

Market environment

The degree of competitiveness in the business and market environment of the firm influences the need for trademark protection (Aaker, 2007). The higher the number of competitors and the greater the need to get recognised by the customers, the greater the number of trademark registrations.

Standardised services

Standardisation in services is on the increase (Blind, 2006). With the help of information and communication technologies, service products can be produced economically in a more industrialised way. With these standardised services, the use of trademarks is more economical. In contrast, customer-specific services are single solutions and therefore not likely to be trademarked (Rammer, 2003). Consequently, the more standardised the services, the greater the likelihood of using trademarks.

Product accompanying services

Quinn et al. (1988) stated that there is interdependence between services and manufacturing. The boundary seems to be quite transparent and varies widely over time. Also, there is a trend, even in manufacturing, where the competition is increasingly decided through products accompanying services (Lee et al., 2010, 23). Therefore, the distinction between products and services is becoming unclear. Trademarks combining a product with a service, such as repair services, are growing considerably (Schmoch, 2003), reflecting the growing relevance of product-related services.

Therefore, if products accompanying services are offered, the use of trademarks will rise.

Company group membership

A single firm that is not part of a bigger company group will use trademark registrations more often than a firm that is part of a group. The single company needs to register IPR on its own and cannot simply use the registered trademarks of the parent company which may manage all IP themes of the company group in a centralised manner.

Company foundation

During the existence of a company, the management gains a lot of experience, such as market and customer experience, but also gains a lot of knowledge on existing laws and IPR. They have a better sense of which instruments are useful and which are not worth the money. Newly founded companies do not seem to have enough experience with IPR, so they will use trademarks less than experienced firms.

Based on this information, we formulate the fourth hypothesis.

***H4**: There are a number of company and environmental characteristics which boost the use of trademarks as a protection method. These characteristics are:*

- *distribution markets are widespread and international*
- *the market environment is very competitive*
- *the percentage of standardised services is high*
- *products accompanying services are offered*
- *company is not part of a company group*
- *foundation of company dates back several years*

The first three hypotheses will be tested using data of the German Community Innovation Survey, while the last hypotheses is tested using the Knowledge Intensive Business Services Survey data.

3.2. Empirical Findings of the Community Innovation Survey

The Community Innovation Survey IV (CIS IV) was conducted in 2005 in most member states of the European Union. For our research we use the German part of CIS IV, which covers manufacturing and service firms in nearly all activities and industries, excluding agriculture and forestry. In order to provide an overview of the different points of interest, Table 1 shows the membership of innovating firms in the sectors and the use of IPR. At first glance, we can state that KIBS have more innovators than KIS firms, "not knowledge intensive services"[4], and low tech manufacturing, but less than high tech manufacturing firms. Another point to mention is that KIS and KIBS both use trademarks rather than patents as IPR. However, manufacturing firms seem to use IPR more frequently than service firms in general.

[4] For readability, "not knowledge intensive services" will be named "services" in the following.

	Innovator (%)	Use of Trademarks (%)	Use of Patents (%)
Low Tech Manufact.	38.4	22.7	22.2
High Tech Manufact.	60.9	37.2	58.9
Services	27.8	11.7	4.8
KIS	36.3	10.1	3.1
KIBS	39.8	14.4	9.8

Table 1: Percentage of innovators and use of IPR in five different sectors
Low Tech Manu (NACE 10-22,25-28,36-45); High Tech Manu (NACE 23,24,29-35);
Services (NACE 50-55,63); KIS (NACE 60-62,64-71); KIBS (NACE 72-74)

In order to test the first two hypotheses, we develop an empirical model with a dependent variable reflecting the innovation success of the firm. As a proxy variable of innovation success, we use the share of turnover achieved with new products and services (market introduction during the last 3 years). A tobit regression analysis was chosen over the more common least squares method because the dependent variable has a censored distribution (with a lower threshold of 0% of turnover with new products and services). Due to the chosen regression model it is not necessary to exclude companies which did not launch a new good or service from our analysis.

For the explanatory variables, we first construct a dummy variable for each formal IPR reflecting whether the firm uses the protection measure or not. Trademarks are not considered to be exclusive, but are more likely an additional protection tool, so other IPRs are also taken into account in the model. Furthermore, we control for several factors that may influence our dependent variable. Innovation input is expected to influence innovation output, so we include innovation input in the model, represented by the level of total innovation expenditures in relation to turnover of the firm. A dummy variable is also included to reflect whether the firm performs continuous R&D or not. Firm size is represented by the number of employees, reflected by three dummy variables indicating whether it is a small, middle-sized, or large company. We describe the geographical dimension of the product market by introducing a dummy variable representing exporting firms. We also control for public financed R&D support. If firms cooperate with others in their innovation activities, this may influence their innovation success, so we include a dummy variable reflecting whether research cooperation takes place.

In addition to the explanatory variables, we create dummy variables for the five sectors introduced in Table 1, in order to first test H1, and in a second step estimate the regression model for the five sectors separately. Table 2 presents the summary statistics and description of the variables used in Models 1 and 2.

Variable	Description	Mean	Min.	Max.
Turnover with new products/services	Percent of turnover achieved with products/ services introduced in the last 3 years	15.01	0	100
Knowl.Int.Serv.	Knowledge Intensive Service Firm	0.12	0	1
Knowl.Int.Bus.Serv.	Knowledge Intensive Business Service Firm	0.18	0	1
High Tech Manuf.	High Tech Manufacturing Firm	0.27	0	1
Low Tech Manuf.	Low Tech Manufacturing Firm	0.37	0	1
Use of Trademarks	Firm uses Trademarks as Protection tool	0.23	0	1
Use of Patents	Firm uses Patents as Protection tool	0.26	0	1
Use of Industrial Designs	Firm uses Industrial Designs as Protection tool	0.19	0	1
Use of Copyrights	Firm uses Copyrights as Protection tool	0.09	0	1
R&D-Intensity	Total innovation expenditures/turnover	4.69	0	94.5
Continuous R&D	Firm performs R&D continuously	0.35	0	1
Middle-sized comp.	Firm has between 50 and 249 employees	0.31	0	1
Large comp.	Firm has more than 249 employees	0.30	0	1
Exporting firm	Firm sells products to foreign countries	0.49	0	1
Public financed	Firm receives public financial support	0.18	0	1
Innovation cooperation	Firm cooperates on innovation activities	0.23	0	1

Table 2: Descriptive statistics of variables used in Model 1 and Model 2 for “All Sectors”

Survey Results

As Table 3 shows, the first hypothesis regarding the innovativeness of KIS and KIBS is not directly supported, because all critical variables are insignificant in our regression model. However, some sample findings can be stated. If a firm belongs to KIS or KIBS sector, a positive effect on innovation success can be observed. Low tech manufacturing firms are even less innovative than ordinary service firms.[5] Like the other variables, high tech manufacturing is insignificant in the model, but the influence is at least positive. Other control variables in the model show the expected signs. Nevertheless, our first hypothesis cannot satisfyingly be answered.

In terms of the second hypothesis, the use of trademarks as a protection measure for the whole sample and in the sectors of high tech manufacturing, services, KIS and KIBS is positive (but insignificant for services). Actually, the use of trademarks has a positive and significant effect to innovation success, whereby this effect is strongest for KIS and KIBS. Considering the control variables, it can be stated that the use of

[5] Ordinary services are not embodied in the output, because they serve as a base.

patents only has a positive significant effect for manufacturing, but for none of the services sectors.

	(1)	(2)	(3)	(4)	(5)	(6)
Turnover with new products/services	All Sectors	Low Tech Manuf.	High Tech Manuf.	Services	KIS	KIBS
Knowl.Int.Serv.	0.0079					
Knowl.Int.Bus.Serv.	0.016					
High Tech Manuf.	0.036					
Low Tech Manuf.	-0.037					
Use of Trademarks	0.034**	-0.011	0,043**	0.11	0.15***	0.12***
Use of Patents	0.025	0.042*	0.055**	0.044	-0.079	-0.030
Use of Ind. Design	0.037***	0.099***	0.017	-0.017	0.065	-0.15***
Use of Copyrights	0.059***	0.063**	0.075***	-0.27*	-0.0058	01.11**
R&D-Intensity	0.77***	0.78***	0.52***	1.22	1.24***	1.05***
Continuous R&D	0.14***	0.14***	0.11***	0.13*	0.15***	0.18***
Middle-sized comp.	0.017	0.020	-0.017	-0.076	0.15**	0.0027
Large comp.	0.0097	-0.0067	-0.051*	0.039	0.14***	0.031
Exporting firm	0.059***	0.063***	0.085***	0.048	-0.029	0.044
Public financed	0.045***	-0.0021	0.083***	0.035	-0.088	0.052
Innovation cooperation	0.055***	0.089***	0.033	0.16*	0.029	0.044
Constant	-0.14***	-0.017***	-0.061**	-0.12***	-0.22***	.0.15***
Observations	4,042	1,486	1,078	273	486	719
Uncens. Observat.	2261	734	829	112	227	359
Pseudo R^2	0.30	0.22	0.32	0.13	0.20	0.30
LR chi-square	1243	299	291	31.1	89.7	242
Prob > chi-square	0.00	0.00	0.00	0.00	0.00	0.00

Tobit regressions with CIS IV (2005), showing β coefficients.
Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

Table 3: Results of Model 1 analysis of selected indicators on innovation success

To conclude, the second hypothesis is supported for the KIS and KIBS sector. The relationship between trademark registration and innovation success is particularly strong and also statistically significant. Therefore, the focus in the test of the third hypothesis is on KIS and KIBS companies.

We now turn to the findings regarding the third hypothesis, which tests if there are differences in the usefulness of trademarks as innovation indicators for the different types of innovation. First, we examine our new dependent variables. The different innovation types are measured as dummy variables indicating whether the firm is an innovator of this single type or not. All explanatory variables remain the same, but as mentioned above, the sample now consists only of KIS and KIBS firms. The dependent variable is binary, so the appropriate statistical technique is a logistic regression. Table 4 shows the results of the logit regression model.

	(1) Product Innovator	(2) Marketing Innovator	(3) Process Innovator	(4) Organisat. Innovator
Use of Trademarks	1.15***	0.24	0.27	0.030
Use of Patents	0.39	0.051	-0.019	0.063
Use of Industrial Design	-1.16***	0.48*	-0.52*	0.20
Use of Copyrights	0.61*	-0.062	0.72**	0.21
R&D-Intensity	6.79***	2.37***	2.16***	1.91**
Continuous R&D	1.11***	0.59***	0.96***	0.85***
Middle-sized comp.	0.38**	0.33*	0.52***	0.36**
Large comp.	0.45***	1.06***	0.55***	1,36***
Exporting firm	0.29*	-0.21	-0.077	-0.056
Public financed	0.43	-0.48*	-0.062	0.0072
Innovation cooperation	0.46**	0.60***	0,32	0.27
Constant	-1.51***	-1.65***	-1.44***	-0.19*
Observations	1,205	1,205	1,205	1,205
Pseudo R^2	0.19	0.081	0.077	0.086
LR chi-square	298	118	116	137
Prob > chi-square	0.00	0.00	0.00	0.00

Logit regression with CIS IV (2005) showing β coefficients.
Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

Table 4: Results of Model 2 analysis of selected indicators for different KIBS innovation types

The analyses show that the third hypothesis was, at least, partly right. Trademark registration seems to be an indicator of innovation. As expected, the use of trademarks increases the likelihood to be a product innovator. But there is also a positive contribution to the odds for creating marketing, process and surprisingly organisational innovations as well. However, only for product innovations the correlation is statistically significant. The positive impact on organisational innovation could be explained through the definition of this innovation type as stated in the Oslo Manual

(OECD, 2005a). Organisational innovation consists not only of implementations in new organisational methods in business practices or workplace organisations (rather back-office activities), but also in changes in external relations. This involves collaborations with suppliers, competitors, and customers, where it seems useful to protect innovations against imitation by partners.

If we control other IPRs which are significant in the model, it is interesting to see that the use of industrial design is only positive for marketing innovations. This makes sense because new product packaging is classified under marketing innovations. No control variables show any particularities. To summarise, trademarks seem to serve as an innovation indicator, but the most for the KIBS industry. Therefore, in the following section we concentrate on this special part of the economy and conduct a survey of KIBS.

3.3. Empirical Findings of the Knowledge Intensive Business Services Survey

The Knowledge Intensive Business Services Survey was conducted in 2009. The sample included Germany-based KIBS listed in the Amadeus company database. The conception of the survey and the item definitions correspond to recommendations given in the Oslo Manual (OECD, 2005a) concerning the measurement and interpretation of innovation survey data. A pretest with ten experts from appropriate firms was performed to optimise the questionnaire.

The main survey was carried out as an online survey with a sample of 6,000 KIBS. The return rate after follow-up is 278 KIBS (corresponding to a response rate of 4.63%). A non-response analysis was conducted in order to assess whether there are differences between responding and non-responding firms. There are no statistically significant differences between the comparison values of the two groups, so one can conclude that the survey is not distorted.

Table 5 shows the make-up of the different sectors of our sample. A comparison test of trademarking and non-trademarking KIBS concerning sector membership indicates that there are obvious differences between the sectors. A Pearson's chi-square test shows that these differences are statistically significant.[6] Therefore, we will take into account the sector membership as dummy variables in the later regression analysis.

Also, Table 5 shows that, with the exception of only two sectors, the use of patents is general lower than the use of trademarks. This result is not surprising, because in contrast to patents, trademarks seem to do particularly well in sectors where patenting data provides no reliable information about innovation activities (Mendonca et al., 2004). As our analysis in Section 3.2 has shown, in all tested innovation models the use of patents was insignificantly correlated with innovation success, at least for KIBS.

[6] df(8)= 26.26, Prob: 0.001

KIBS industries	Sample part	Use of Trade-mark	Use of Patent
Publishing of books, periodicals and other publishing activities	4.68	**53.85**	0.00
Software publishing	5.04	**57.14**	35.71
Computer programming, consultancy and related activities	29.5	**39.02**	7.32
Data processing, hosting and related activities, web portals	2.52	**85.71**	14.29
Architectural and engineering activities	22.66	**17.46**	15.87
Technical testing and analysis	2.16	16.67	**50.00**
Research and exper. development on natural science and engineering	7.55	47.62	**66.67**
Research and exper. development on social science and humanities	2.88	**62.50**	12.50
Others	23.02	**43.75**	26.56
All KIBS-Sectors	**100**	**38.85**	**20.50**

Table 5: Differences between different KIBS industries (All data in percent)

As the low use of patents was expected, a question was included in the survey regarding the reason for the non-use of patents. As Figure 1 shows, KIBS mainly do not use patents because their innovations are not based on technical inventions, which is a necessary precondition to achieve patent protection.

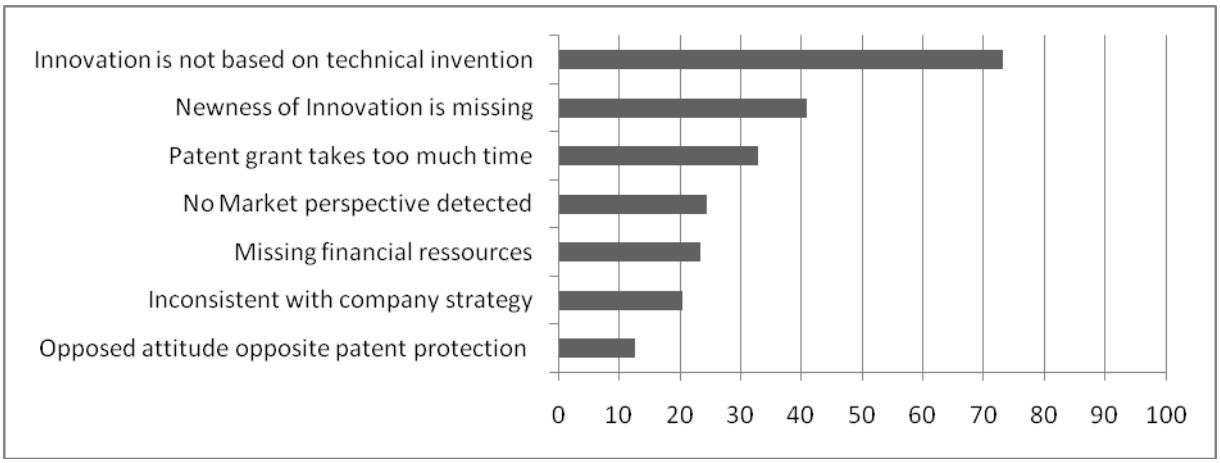

Fig. 1: Reasons for KIBS not to use patents as a protection tool (All data in percent)

We now turn to the interesting variables regarding the fourth hypothesis. H4 includes some assumptions about which factors might explain the use of trademarks. However, before we concentrate on these characteristics, we test whether trademarking KIBS are more innovative than non-trademarking KIBS. A t-test is first performed using the percentage of turnover achieved with new services as the metric variable and searching for differences between trademarking KIBS (47% turnover with new services) and non-trademarking KIBS (42% turnover with new services), but the test shows no significance (Prob: 0.213). Therefore, we use another proxy variable for innovation, a dummy variable reflecting whether the firm introduced new services in

the last three years. Using this operationalisation, a chi-square test shows that 87% of trademarking KIBS are innovative. Of the non-trademarking KIBS, only 72% are innovative firms. The difference is significant (Prob: 0.003), indicating that there is a correlation between the decision to use trademarks and the likelihood of being an innovative KIBS.

The comparison of trademarking and non-trademarking KIBS will now concentrate on the hypotheses built in Section 3.1. We investigate whether there are differences concerning the international activities, degree of competition, standardisation of services, membership in a company group, and age of the firm. The results are summarised in Table 6.

Variable	Test	Sig.	User of Trademark	Non-User of Trademark
Percentage of turnover achieved with new services	t-test	0.213	47%	42%
Firm introduced new services in the last 3 years	Chi^2	**0.003*** **	87%	72%
Distribution market: Worldwide	Chi^2	0.230	27%	20%
Degree of competition: Threat by new competitors	Chi^2	0.880	54%	55%
Percentage with standardised services	t-test	**0.031** **	43%	33%
Part of an enterprise group	Chi^2	0.202	23%	16%
Company foundation in the last four years	Chi^2	0.821	9%	10%

Table 6: Disparity tests for users and non-users of trademarks

We only find a significant result for the case of standardised service products (Prob: 0.031). The percentage of turnover achieved with standardised services is 43% for trademarking KIBS, while non-trademarking KIBS achieve only 33% of their turnover with standardised services.

In order to better answer the fourth hypothesis, we estimate a regression model. The dependent variable is the frequency of trademark registration, which is an ordinal variable with five acceptable values. The exact wording of the question is: “How frequently do you use trademarks as a protection measure?” The respondent is given five response options: never or rarely, sometimes, regularly, often, and permanently. Due to the scaling we estimate an ordered logistic regression model, which is used to examine the impact of a range of explanatory variables on a dependent variable that takes a finite set of ordered values.

Next we define the explanatory variables. The characteristics developed in Section 3.1 are operationalised as follows: The internationality of the distribution markets of the firm is covered by three dummy variables indicating whether the KIBS is active only in Germany, in the European Union, or worldwide. In order to capture the competitiveness of the market environment, we include a dummy variable reflecting a high threat of new competitors. We also take into account the number of already existing competitors of the firm in Germany. Dealing with the question on influence of standardisation, we include the percentage of turnover achieved with standardised services in the model. Furthermore, we construct a dummy variable indicating

whether the firm offers a product accompanying services. Another dummy variable indicates whether the company is a part of a company group. With reference to the age of the firm, a dummy variable is included reflecting whether the company foundation dates back less than four years. Additionally, we control for innovation success and firm size (represented by the number of employees). In addition to the explanatory variables, we create dummy variables for each of the KIBS sectors introduced in Table 5. Finally, Table 7 presents the summary statistics for the variables used in Model 3.

Variable	Mean	S.D.	Min.	Max.
Frequency of trademark registration	2.40	1.14	1	5
Distribution market: Germany	0.45	0.50	0	1
Distribution market: European Union	0.15	0.36	0	1
Distribution market: Worldwide	0.27	0.44	0	1
Threat by new competitors	0.49	0.50	0	1
Number of competitors in Germany	95.66	407.25	2	3000
Percentage with standardised services	45.25	32.27	0	100
Product accompanying services	0.35	0.48	0	1
Part of an enterprise group	0.27	0.44	0	1
Company foundation in the last four years	0.10	0.30	0	1
Turnover with new services	49.32	31.23	0	100
Number of employees	69.77	145.02	4	1044

Table 7: Descriptive statistics of variables used in Model 3

Survey Results

The results of the ordered logistic regression model are presented in Table 8, which shows all theoretically identified variables concerning the use of trademarks as a protection tool for IP. The fourth hypothesis is partly supported. Most of the different characteristics expected to increase the use of trademarks indeed do so. In the following, we discuss all influencing factors in detail.

Concerning the internationality of the distribution markets, the further and more international the distribution markets, the stronger the likelihood of trademark activities. If the market environment is very competitive, measured by a high number of existing competitors, an increasing likelihood to use trademarks can be observed. In comparison, the threat of newly entering competitors is insignificant in our model. One can conclude that KIBS use trademarks for IPR and protection against already active competitors and are less likely to use them for resistance against only potential rivals.

	(1) Trademark Registration
Distribution market: Germany	3.02**
Distribution market: European Union	3.23**
Distribution market: Worldwide	3.72***
Threat by new competitors	0.66
Number of competitors in Germany	0.0016**
Percentage with standardised services	0.026**
Product accompanying services	1.33*
Part of an enterprise group	-1.83**
Company foundation in the last four years	-1.16
Turnover with new services	-0.0036
Number of employees	0.00022
Publishing of books, periodicals, and other publishing activities	5.44***
Software publishing	3.22*
Computer programming, consultancy, and related activities	3.82**
Architectural and engineering activities	2.36
Technical testing and analysis	3.16
Research and experimental development in natural sciences and engineering	4.28**
Research and experimental development in social sciences and humanities	2.83
Others	3.95**
Constant	10.9***
Observations	58
Pseudo R^2	0.23
LR chi-square (19)	36.19
Prob > chi-square	0.01

Ordered logistic regression with KIBS survey (2009), showing coefficients.
Sector (Data processing, hosting, and related activities) dropped.
Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1

Table 8: Results of Model 3 analysis concerning the use of trademarks

Our theoretical model predicts that a high percentage of standardised services boosts trademark registration. This is confirmed by the results of the model. The percentage of turnover achieved with standardised services has a positive significant effect on the use of trademark protection. There is also a positive effect of KIBS firms

offering products accompanying services on trademark use, though it is less significant. Surprisingly, there is a negative effect of the company being part of a company group on the use of trademarks. This may be due to the fact that subsidiary companies use the trademarks of their parent company and do not register their trademarks on their own. The time point of the foundation of a company does not seem to be important for the decision to use trademarks or not, as the foundation variable is insignificant in our model. All other control variables in the model are insignificant as well.

If we concentrate on the different KIBS sectors, one can observe that there are indeed disparities between the sectors as a previously conducted chi-square test and Table 5 predicted. In four sectors - “Publishing of books, periodicals, and other publishing activities “, “Software publishing”, “Computer programming, consultancy, and related activities” and “Research and experimental development in natural sciences and engineering” - a positive significant effect can be found, which can be interpreted as trademarks being used more frequently in these sectors. Therefore, trademarks might be used as a particularly suited indicator for the named sectors.

4. Conclusion

As the aim of this paper was to explore the extent to which trademarks are suitable as innovation indicators for knowledge intensive services, we can conclude that trademarks are at least useful, because we obtain information from them about innovation activities and the innovation success of KIBS firms. The final conclusions regarding the results of the two surveys are presented in the following section.

4.1. Suitability of Trademarks as an Innovation Indicator for Knowledge Intensive Services

The KIS and KIBS sector includes a very innovative bunch of firms worthy of in-depth investigations. Due to the lack of existing, adequate indicators for innovation activities, the use of trademark registrations as an additional indicator must be explored. As the results of our first model have shown, the interrelation between trademark registration and innovation success is particularly strong and also statistically significant in the KIS and KIBS sector. Hence, trademarks contribute to explaining KI(B)S innovation. However, one has to keep in mind that indicators, such as trademarks in this case, are just an indication of reality, not a direct and complete measure, and are likely to be imperfect. However, according to the explanation content of an IPR, the conventional use of patents as an innovation indicator in manufacturing industries is very similar.

The results of the second model show that trademark registration appears to be an indicator of innovation in KIS and KIBS industries. As expected, the explanatory power of trademark registrations is especially high and significant for product innovations. Trademarks are obviously a market-based IPR. One cannot use them as an indicator for company’s inside process innovations, which is, admittedly, a limitation of this measure as compared with patents.

Concerning which firm inside and outside characteristics influence the use of trademarks, we can conclude that some features raise the number of trademark registra-

tions. International distribution markets, competitive market environments, and highly standardised or products accompanying services increase the likelihood of trademark registrations. This means that KIBS with these characteristics are more likely to be users of trademarks as compared with other KIBS. Moreover, the model shows that there are differences among the individual KIBS sectors. All of these disparities must be taken into account when trademarks are used as an indicator of KIBS innovation.

4.2. Prospects for Future Research

There are many challenging tasks and questions that remain unanswered. With further investigation, the research questions can be answered in a more detailed way. In addition, future research is needed to elaborate upon which connections or influences are observed between formal and informal protection practices, like secrecy or lead time advantages. Other interesting issues concerning, for example, the motives of trademark registrations of KIBS should be considered as well.

If the correlation between trademarks and innovation is made clear, there still remain some bigger problems. For example, a simple count of trademark registrations is affected by various sources of bias such as difficulties in data consolidation, sectoral differences, and weaknesses in international comparability (Mendonca et al., 2004). Therefore, for a full assessment of trademarks as an innovation indicator for KIS and KIBS, further research is obviously needed. The final goal would be the development of a multi-indicator approach, taking into account a combination of possibilities with already existing indicators. By doing so, the use of trademarks as an additional indicator could contribute to an improved innovation model for KIS and KIBS.

References

Aaker, D. (2007): Innovation: Brand it or lose it. California Management Review 50, pp. 8–24.

Abreu, M.; Grinevich, V.; Kitson, M.; Savona, M. (2008): Taking services seriously. How policy can stimulate the 'hidden innovation' in the UK's services economy. NESTA, London.

Amara, N.; Landry, R.; Doloreux, D. (2009): Patterns of innovation in knowledge-intensive business services. The Service Industries Journal 29, pp. 407–430.

Amara, N.; Landry, R.; Traore, N. (2008): Managing the protection of innovations in knowledge-intensive business services. Research Policy 37, pp. 1530–1547.

Arundel, A.; Kanerva, M.; van Cruysen, A.; Hollanders, H. (2007): Innovation Statistics for the European Service Sector. UNU-MERIT. Maastricht.

Blind, K. (2006): A Taxonomy of Standards in the Service Sector: Theoretical Discussion and Empirical Test. The Service Industries Journal 26, pp. 397–420.

Blind, Knut; Edler, Jakob; Schmoch, Ulrich; Anderson, Birgitte; Howells, Jeremy; Miles, Ian et al. (2003): Patents in the Service Industries. Final Report. Fraunhofer Institute Systems and Innovation Resarch. Karlsruhe.

Camacho, J.; Rodriguez, M. (2005): How Innovative are Services? An Empirical Analysis for Spain. Service Industries Journal 25, pp. 253-271.

Coombs, R.; Miles, I. (2000): Innovation, Measurement and Services: The New Problematique. In: Metcalfe, J.; Miles, I. (ed.): Innovation Systems in the Service Economy: Measurement and Case Study Analysis. Springer, pp. 85–103.

Den Hertog, P. (2000): Knowledge-Intensive Business Services as Co-Producers of Innovation. International Journal of Innovation Management 4, pp. 491–528.
Drejer, I. (2004): Identifying innovation in surveys of services: a Schumpeterian perspective. Research Policy 33, pp. 551–562.
Gallouj, F. (2002): Knowledge-intensive business services: processing knowledge and producing innovation. In: Gadrey, J.; Gallouj, F. (ed.): Productivity, Innovation and Knowledge in Services. New Economic & Socio-Economic Approaches. Cheltenham: Edward Elgar Publishing, pp. 256–284.
Gallouj, F.; Weinstein, O. (1997): Innovation in services. Research Policy 26, pp. 537–556.
Gatrell, J..; Ceh, S. L. B. (2003): Trademark data as economic indicator: The United States, 1996-2000. The Great Lakes Geographer 10, pp., S. 46–56.
Gauch, S.; Schmoch, U. (2005): Marken als Innovationsindikator. Studien zum deutschen Innovationssystem 10-2005. Fraunhofer Institute Systems and Innovation Resarch. Karlsruhe.
Greenhalgh, C.; Rogers, M. (2005): Trade Marks and Productivity in UK Firms. Oxford Intellectual Property Research Centre. Oxford.
Greenhalgh, C.; Rogers, M. (2007): Trade Marks and Performance in UK Firms. DIME Working Papers on Intellectual Property Rights: Working Paper No 27.
Hipp, C.; Grupp, H. (2005): Innovation in the service sector: The demand for service-specific innovation measurement concepts and typologies. Research Policy 34, pp. 517–535.
Kanerva, M.; Hollanders, H.; Arundel, A. (2006): TrendChart Report: Can We Measure and Compare Innovation in Services? MERIT - Maastricht Economic Research Institute on Innovation and Technology. Maastricht.
Lee, C.; Chen, Y.; Ho, J..; Hsieh, P. (2010): An integrated framework for managing knowledge-intensive service innovation. International Journal of Services Technology and Management 13, pp. 20–39.
Leiponen, A. (2006): Organization of Knowledge Exchange: An Empirical Study of Knowledge-Intensive Business Service Relationships. Economics of Innovation and New Technology 15, pp. 443–464.
Livesey, F.; Moultrie, J. (2008): Do trademarks and design registrations provide a better perspective on national innovation activity? DIME Conference on the Creative Industries and Intellectual Property. London.
Malmberg, C. (2005): Trademarks Statistics as Innovation Indicator? - A Micro Study. CIRCLE Electronic Working Paper Series: Paper no. 2005/17. Lund.
Mendonca, S.; Pereira, T.; Godinho, M. (2004): Trademarks as an indicator of innovation and industrial change. Research Policy 33, pp. 1385–1404.
Miles, I. (2008): Patterns of innovation in service industries. IBM Systems Journal 47, pp. 115–128.
Miles, I. (2005): Knowledge intensive business services: prospects and policies. Foresight 7, pp. 39–63.
Miles, I. (2000): Services Innovation: Coming of Age in the Knowledge-based Economy. International Journal of Innovation Management 4, pp. 371-389.
Millot, V. (2009): Trademarks as an Indicator of Product and Marketing Innovations. Paris. OECD Science, Technology and Industry Working Papers, 2009/6.
Muller, E.; Doloreux, D. (2009): What we should know about knowledge-intensive business services. Technology in Society 31, pp. 64–72.
Muller, E.; Zenker, A. (2001): Business services as actors of knowledge transformation and diffusion. Fraunhofer Institute Systems and Innovation Research. Karlsruhe.

OECD (2005a): Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. Third Edition, Paris: OECD Publishing.
OECD (2005b): Enhancing the performance of the service sector. Paris: OECD Publishing.
OECD (2002) Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development. Paris: OECD Publishing.
Päällysaho, S.; Kuusisto, J. (2008): IP protection as a key driver of service innovation: an analysis of innovative KIBS businesses in Finland and the UK. International Journal of Services Technology and Management 9, pp. 268–284.
Quinn, J.B.; Paquette, P.C.; Baruch, J.J. (1988): Exploiting the manufacturing-services interface. Sloan Management Review 29, pp. 45-56.
Rammer, C. (2007): Innovationsverhalten der Unternehmen in Deutschland 2005. Studien zum deutschen Innovationssystem 13-2007. Center of European Economic Research (ZEW), Mannheim.
Rammer, C. (2003): Patente und Marken als Schutzmechanismen für Innovationen. Studien zum deutschen Innovationssystem 11-2003. Center of European Economic Research (ZEW). Mannheim.
Schmoch, U.; Gauch, S. (2009): Service marks as indicators for innovation in knowledge-based services. Research Evaluation 18, pp. 323–335.
Schmoch, U. (2003): Service marks as novel innovation indicator. Research Evaluation 12, pp. 149–156.
Sundbo, Jon (1997): Management of Innovation in Services. In: The Service Industries Journal, Jg. 17, H. 3, S. 432–455.
Sundbo, J.; Gallouj, F. (2000): Innovation as a loosely coupled system in services. International Journal of Services Technology and Management 1, pp. 15–36.
Toivonen, M.; Tuominen, T. (2009): Emergence of innovations in services. The Service Industries Journal 29, pp. 887–902.
van Ark, B.; Broersma, L.; Den Hertog, P. (2003): Services Innovation, Performance and Policy: A Review. Synthesis Report in the Framework of the Structural Information Provision on Innovation in Services.

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