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Zentrum für Europäische Wirtschaftsforschung GmbH
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Non-Technical Summary

Social software serves in particular the communication, cooperation and information sharing between individuals and includes applications like blogs, wikis or online communities. Common to all of these applications is that they are web-based and self-organising. Social software interlinks users and their knowledge and pursues the open content principle. Thereby, it has different potentials of use, e.g. in the knowledge management. Due to its application in the knowledge management where it creates knowledge transparency and new knowledge and, moreover, supports knowledge exchange via faster access to information, more efficient communication and appropriate tagging and linking, social software has the potential for supporting the innovative capability of firms.

As a theoretical framework, this study employs a knowledge production function, explaining the production of new knowledge by the use of specific input factors. In this knowledge production function, often referred to as innovation production function, the application of social software constitutes the knowledge sourcing activity. Furthermore, this study tries to identify whether there is a difference between the impact of knowledge sourcing activity focusing on external knowledge and focusing on internal knowledge.

Using data from 505 German Information- and Communication Technology (ICT) and knowledge-intensive service firms, this paper finds that firms which use social software are more likely to innovate. Taking into account former innovative activities of the firm and its previous propensity to adopt new technologies and to change processes, the analysis suggests a causality between social software use and innovation that runs from social software to service innovation. The analysis reveals no robust results on the impact of knowledge sourcing activity focusing on external knowledge and on internal knowledge and thus allows no statement on different impacts of social software use according to its application purpose.

Das Wichtigste in Kürze

Soziale Software dient insbesondere der Kommunikation, Kooperation und Informationsweitergabe von Individuen und beinhaltet Anwendungen wie Blogs, Wikis oder Online-Communities. Diese Anwendungen sind alle webbasiert und selbstorganisierend. Soziale Software verbindet Nutzer und deren Wissen und basiert auf dem Prinzip der freien Inhalte. Damit besitzt sie verschiede Nutzungsmöglichkeiten, zum Beispiel im Bereich des Wissensmanagements. Aufgrund ihrer Anwendung im Wissensmanagement, wo sie Wissenstransparenz und neues Wissen erzeugt sowie den Wissensaustausch über einen schnelleren Zugriff auf Informationen, effizientere Kommunikation und angemessene Kennzeichnung und Verlinkung unterstützt, hat soziale Software das Potential, die Innovationsfähigkeit von Firmen zu unterstützen.

Als theoretischer Rahmen dieser Studie fungiert eine Wissensproduktionsfunktion, die die Erzeugung neuen Wissens mit Hilfe von spezifischen Input-Faktoren erklärt. In dieser Wissensproduktionsfunktion, häufig als Innovationsproduktionsfunktion bezeichnet, stellt die Nutzung von sozialer Software die Aktivität der Wissensbeschaffung dar. Darüber hinaus versucht diese Studie herauszufinden, ob es einen Unterschied zwischen dem Einfluss der Wissensbeschaffungsaktivität gibt, je nachdem ob sie sich auf externes oder internes Wissen fokussiert.

Basierend auf Daten von 505 deutschen Informations- und Kommunikationsdienstleistern und wissensintensiven Dienstleistern, kommt diese Studie zum Ergebnis, dass Firmen, die soziale Software einsetzen, eine höhere Innovationswahrscheinlichkeit haben. Unter Berücksichtigung vorhergehender Innovationsaktivitäten der Firma und ihrer bisherigen Neigung, neue Technologien einzusetzen und Abläufe zu verändern, deutet die Analyse auf eine Kausalität hin, die von sozialer Software zu Dienstleistungsinnovation verläuft. Die Analyse zeigt keine robusten Ergebnisse zum Einfluss der Wissensbeschaffung, je nachdem ob diese sich auf externes oder internes Wissen fokussiert. Daher ist es nicht möglich eine Aussage hinsichtlich des Unterschieds zwischen dem Einfluss von internem oder externem Wissen auf Innovation zu treffen.

Does Social Software Support Service Innovation?*

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Abstract

Recent Internet technologies and web-based applications, such as social software, are being increasingly applied in firms. Social software can be employed for knowledge management and for external communication enabling access to internal and external knowledge. Knowledge in turn constitutes one of the main inputs to service innovation. Hence, social software has the potential to support service innovation. Using data from 505 German Information- and Communication Technology (ICT) and knowledge-intensive service firms, this is the first paper which empirically analyses the question whether the use of social software applications triggers innovation. Thereby, it refers to a knowledge production function in which social software use constitutes the knowledge sourcing activity. The results reveal that there is a positive relationship between social software and service innovation. Since this result is robust when controlling for former innovative activities and the previous propensity to adopt new technologies and to change processes, the analysis suggests that the causality runs from social software to innovation.

JEL-classification: O31, O33, M10

Keywords: social software, web 2.0, service innovation, knowledge management

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1 Introduction

Recent Internet technologies and web-based applications, frequently described with the headword web 2.0, do not only penetrate and change the private internet usage and communication behaviour, but are increasingly applied in firms. Social software is part of the term web 2.0, but has up to now no standard definition. It serves in particular the communication, cooperation and information sharing between individuals and includes applications such as blogs, wikis or online communities.[1] Common to all of them is that they are web-based and self-organising. Social software interlinks users and their knowledge and pursues the open content principle. Thereby, it has different potentials of usage.

Due to its application in the knowledge management where it creates knowledge transparency and new knowledge and supports knowledge exchange via a faster access to information, more efficient communication and appropriate tagging and linking, social software has the potential to support the innovative capability of firms. Improved knowledge management hence may lead to the development of new processes and services. Furthermore, social software can be actively applied to viral marketing and customer retention as well as passively to business-intelligence. Therefore, the application of social software to external communication can improve the firm's access to customers and their knowledge and information, i.e. its access to external knowledge.

Using data from 505 German Information- and Communication Technology (ICT) and knowledge-intensive service firms, this is the first paper which empirically tests the hypothesis whether the use of social software applications triggers service innovation. Permanent innovation is one of the most important conditions for staying competitive, as has been shown by theoretical approaches like those of Aghion, Bloom, Blundell, Griffith, and Howitt (2005) or Aghion, Blundell, Griffith, Howitt, and Prantl (2006). Although this is true for innovations of the manufacturing industries as well as for those of the service sectors, innovative activities and capabilities of service firms have been empirically less investigated than those of manufacturing firms. The service sector differs from the manufacturing sector with respect to its products and their production and thus there are differences with regard to the innovative behaviour. Service products are intangible and difficult to protect via patents. Furthermore, services are characterised by an intense interactivity between supplier and client and are often produced and consumed at the same time (Evangelista 2000, Miles 2005). The result of these characteristics is a high importance of internal knowledge, embodied in the employees, and of external knowledge, such as information of customers, partner and competitors for innovations in the service sector.

[1] A blog is a web page where entries are ordered chronologically, beginning with the latest entry and the possibility to comment on the entries. A wiki is a web page where every user can add or change content. An online community is a virtual community of users in the Internet.

As theoretical framework, a knowledge production function (Griliches 1979, Pakes and Griliches 1984) is employed in which the application of social software constitutes the knowledge sourcing activity. Furthermore, this study tries to identify whether there is a difference between the impact of knowledge sourcing activity focusing on external knowledge and focusing on internal knowledge. In particular, the following questions will be analyzed: Are firms which apply social software more likely to innovate? Does the purpose of the social software use affect the probability of service innovation differently or is the effect of internally and externally applied social software the same?

The results of Probit estimations show that ICT and knowledge intensive service firms that use social software are more likely to innovate. Taking into account former innovative activities of the firm and its previous propensity to adopt new technologies and to change processes, the analysis suggests a causality between social software use and innovation that runs from social software to service innovation. There are no robust results on the impact of knowledge sourcing activity focusing on external knowledge and on internal knowledge. This might be due to the data in which only few firms which use social software exclusively for internal or external purposes are observed. Thus, the analysis allows no statement on different impacts of social software use according to its application purpose.

The paper is organised as follows: Section two reviews the literature on service innovation, defines social software, gives some insights on knowledge management and innovation and derives the research question. A description of the data set is given in section three. Section four presents the analytical framework and the empirical strategy. Section five describes and interprets the results. Section six concludes and gives an outlook on further demands on research.

2 Background Discussion and Hypothesis Derivation

The analysis and measurement of innovation in services and the distinction between process, product or organisational innovations is difficult (Gallouj and Weinstein 1997, den Hertog 2000). Gallouj and Weinstein (1997) stress two reasons for that. Firstly, innovation theory has been developed on the basis of the analysis of technological innovation in manufacturing. Secondly, the nature of services complicates the use of traditional economic measurements. The nature of services implies the often mentioned features of intangibility, interactivity and coterminality: Service products are harder to store, to transport and to export compared to manufacturing products (intangibility). There is intense interactivity between supplier and client and, in most service processes, both have

to be present for the transaction (interactivity). The production and consumption of services occur at the same time and place (coterminality). Thus, innovation may focus more on these particular characteristics (Miles 2005, 2008). According to Gallouj and Weinstein (1997), the two reasons mentioned above led to two complementary groups of studies on innovation in services. The first group focuses on analysing the introduction of technical equipment or IT as a service innovation or at least as a starting point of service innovation.[2] The second group deals with non-technological, service-oriented innovation. Although this paper analyses the relation between IT-use (in this case social software) and service innovation, it refers to the second group because here, IT is not intended to provide the services or to change the quality of service provision, but to improve the connections to the sources of knowledge needed for service innovation.

Innovation in services relies mainly on two important features: the internal knowledge within the organisation and its employees and the external network of the firm including customers and other businesses (Sundbo 1997). Human capital and knowledge about markets, consumer habits and tastes play a crucial role in the strategic asset of a service firm. Clients, customers and suppliers of equipment are important information sources (Evangelista 2000). Thether (2005) identifies these two features as the "softer" sources of innovation, compared to the "hard" sources of technology and knowledge (such as from R&D or acquired technologies), which manufacturers rather place emphasis on. Since the literature on service innovation has grown, there is various empirical evidence on the determinants of service innovation.[3] This literature supports the hypothesis that these "softer" inputs to innovation play a crucial role in service innovation.[4]

Social software is a concept with no hard boundaries. Summarising the literature on social software reveals that social software encompasses web-based applications which link persons and support communication, interaction and cooperation (e.g. Hippner 2006, Alby 2007, Döbler 2007, Raabe 2007, Back and Heidecke 2008). The idea behind social software is mainly based on the web 2.0 principle of harnessing collective intelligence.[5] Thus, to fulfil its purpose to link persons and to support communication, interaction and

[2]See for instance Barras (1990), Evangelista, Sirilli, and Smith (1998), Licht and Moch (1999), Evangelista (2000) or Freel (2006).

[3]A great deal of the literature on service innovation considers knowledge-intensive business services (KIBS). Although this paper uses data from ICT- and knowledge-intensive services, it will not focus on the KIBS-literature and the innovation in KIBS. For a review, see for instance Leiponen (2005) or Koch and Strotmann (2006).

[4]See for instance Hipp, Tether, and Miles (2000), Arvanitis and von Arx (2004), Leiponen (2005), Thether (2005), Leiponen (2006), Koch and Strotmann (2006), Schibany, Berger, Streicher, and Gassler (2007), Arvanitis (2008) and Love, Roper, and Hewitt-Dundas (2008).

[5]O'Reilly (2005) coined and clarified the term web 2.0 in his seminal article. According to him, the basic characteristics of applications typical for web 2.0 are: the web as a platform, harnessing collective intelligence, data-driven applications, end of the software release circle ("perpetual beta"), lightweight programming models, software above the level of a single device and rich user experiences.

cooperation among them, social software uses the potential, contributions and knowledge of a network of participants (Back and Heidecke 2008). Social software is self-organised, transparent and supports social feedback (Hippner 2006, Alby 2007, Raabe 2007). From most authors' points of view, applications such as wiki, blog, web forum (discussion forum, internet forum), instant messaging, social bookmarking, folksonomy, social networks (online communities), podcast (vodcast) and vlog can be assigned to social software.[6]

Commonly, ICT-applications are employed in firms before they diffuse into private usage. However, considering social software, the reverse is true. Applications such as wikis, blogs and social networks have been applied by private users before diffusing into firms. Within a firm, social software can be applied for different purposes. On the one hand, it can be used for external communication or for customer relationship management, marketing, market research or cooperations with other firms and partners. On the other hand, it can be utilised for internal communication, including for example knowledge management, project management or product development.[7] This paper focuses on social software as a knowledge management tool. Thereby, social software has two functions: the pooling and management of internal knowledge and the enabling of access to external knowledge.

As pointed out, internal and external knowledge is important for service innovation. The cooperation with externals needs to be sustained by enabling access to their knowledge. The particularities of knowledge and its importance in the innovation process require appropriate management. The knowledge management concept developed by Probst, Raub, and Romhardt (2006) consists of eight components: knowledge goals, identification, acquisition, development, dissemination, use, preservation and evaluation. Social software could be used for every component of this knowledge management concept. For instance, the transparency inherent in social software can support knowledge identification. Knowledge acquisition can be supported by connecting with partners and customers via social networks. Wikis or blogs could be useful for knowledge dissemination and preservation because on the one hand, they store information and on the other hand, they make it accessible for others. Knowledge evaluation could be supported by the social feedback function of social software. The knowledge spiral by Nonaka and Takeuchi (1997) shows how knowledge is transferred and new knowledge is created within a firm. Knowledge can be subdivided into implicit knowledge, which is personal, context-specific and thus hard to communicate, and explicit knowledge, which can be passed on in a formal and systematic language. The knowledge spiral consists of four phases: socialisation (implicit knowledge is transferred into implicit knowledge), externalisation (implicit knowledge is

[6]See for instance Alby (2007) and Hippner (2006) for a definition of these applications.

[7]See for instance Raabe (2007), Döbler (2008) and the articles in Hildebrandt and Hofmann (2006) or in Back, Gronau, and Tochtermann (2008) for details, case studies and examples of the social software adoption in several business areas.

transferred to explicit knowledge), combination (explicit knowledge is transferred into explicit knowledge) and internalisation (explicit knowledge is transferred into implicit knowledge). Social software could support parts of the four phases. The externalisation process is caused by a constructive dialogue that externalises implicit knowledge via joint metaphors or analogies. The tagging of contents and creation of tag clouds for particular topics might support the externalisation. The combination is created by connecting new and existing knowledge to build for instance a new service or management system. The commentating of existing content and the linking of different contents are a function of social software that could facilitate the combination phase.

Although knowledge plays the key role in innovation, the empirical work on the relationship between knowledge management and innovation is rather scarce and little developed (Hall and Mairesse 2006). There is some literature that finds a positive correlation between the use of knowledge management practices and innovation: e.g. Darroch (2005), who uses a total of 16 factors, such as valuing employees attitudes and opinions and encouraging employees to up-skill, using techniques such as quality circles, case notes, mentoring and coaching to disseminate knowledge or responding to knowledge about customers, competitors and technology, to identify knowledge management. One of these factors representing knowledge management is the use of technology (such as teleconferencing, videoconferencing and Groupware) to facilitate communication and disseminate knowledge. The correlation between technology as a management tool and radical innovation is positive. However, Darroch and McNaughton (2002) find a positive impact for less than half of their knowledge management measures only. Cantner, Joel, and Schmidt (2009) find a positive effect regarding the application of knowledge management connected to innovative success. Firms which apply knowledge management achieve higher shares of turnover with innovative products. They focus on six collaborative (between departments) knowledge management techniques, such as joint development of innovation strategies, open communication of ideas and concepts among departments or temporary exchange of personnel. In their measurement, firms with knowledge management activities have to perform at least three of the six knowledge management tools. Czarnitzki and Wastyn (2009) use three different knowledge management practices to analyse different innovation outputs. They find that stimuli for active knowledge sharing among employees have a positive impact on unit cost reduction by process innovations. The acquisition of external knowledge and codified knowledge management policy have a positive effect on the introduction of new products or services and codified knowledge management policy also positively affects market novelty innovations.

Furthermore, there are a few studies, based on theoretical considerations, case studies or use cases, which analyse the employment of information technology in knowl-

edge management and collaboration and its relation to innovation and product development (see for instance Adamides and Karacapilidis 2006, Christensen, Magnusson, and Zetherstrom 2006, Sethi, Pant, and Sethi 2003). There is some case study evidence on the adoption of social software, mainly wikis and blogs, in the knowledge management of several firms (e.g. Müller and Dibbern 2006, Ehms 2008, Hilzensauer and Schaffert 2008). To the best of my knowledge, none of the studies analyzing the relationship between knowledge management and innovation have considered social software as a knowledge management tool. Furthermore, the studies on social software adoption in the knowledge management have not considered its impact on innovation. Hence, there is no empirical evidence on the use of social software as a knowledge management tool and its impact on service innovation — this paper closes this research gap.

Based on theoretical considerations, I expect a positive relationship between social software and innovation: Social software can be used as an adequate knowledge management and knowledge sourcing tool as it not only supports the internal knowledge preservation, dissemination and creation, but also the acquisition of external knowledge. If knowledge is a prerequisite for innovation and social software bundles and manages knowledge, then social software should support service innovation. Since internal and external knowledge are two different sources of knowledge, they might have a different impact on service innovation. Thus, there might be a difference regarding the impact of social software use on innovation depending on whether social software is used for internal or external purposes.

3 Description of Data

The data used for the empirical analysis is taken from the quarterly business survey among the "service providers of the information society" conducted by the Centre for European Economic Research (ZEW) in cooperation with the credit rating agency Creditreform. The sector "service providers of the information society" comprises nine industries belonging to the information and communication technology service providers (e.g. software and IT services) and the knowledge-intensive service providers (e.g. tax consultancy and accounting).[8] Every quarter, a single-page questionnaire is sent to about 3,500, mostly small- or medium-sized, firms. This random sample is stratified with respect to company size, region and sector affiliation. In each wave, the survey achieves a response rate of about 25%. The questionnaire is divided into two parts. In the first part, firms assess their current business development with respect to the previous quarter as well as their expectations for the next quarter. The second part is dedicated to questions concerning ICT usage and further economic issues, such as innovative activities or training behaviour.

[8]For further details on the nine industries, their industrial classification and their distribution within the sample, see the data description and Table 7 in the appendix.

The questions of the second part change quarterly with selected questions being repeated annually. The survey is designed as a panel. The detailed questions on the use of social software as well as on innovations were asked for the first time. Therefore, panel data estimations such as fixed effects or random effects cannot be provided. This paper uses the data collected in the first and second quarter of the year 2008. The wave of the first quarter of 2008 contains information on the use of social software and the wave of the second quarter of 2008 comprises data on the innovation activities. The two waves are merged. Considering item non-response for social software and innovation, a sample of 505 firms remains.

Former waves of the data have previously been used to analyse for instance the productivity effects of organisational change (Bertschek and Kaiser 2004), the relationship between managerial ownership and firm performance (Mueller and Spitz-Oener 2006) and the impact of the age structure of the workforce on technology adoption (Meyer 2008).

As already noted, it is difficult to measure innovation in services and to distinguish between process, product or organisational innovations. Furthermore, the self-assessment of service firms regarding their innovative activity adds to this difficulty. Hipp, Tether, and Miles (2000) show that the self-assessment of the firms about the kind of innovation accomplished and the classification made by one of the authors differed. Thus, instead of asking firms if they innovated, it seems to be more appropriate to ask them about activities that are supposed to be service product innovations including some specific examples. Thus, we have two dummy variables representing service innovation activities: broadening and differentiation of the range of services offered. Broadening means that the firms broadened their services offered during the last twelve months, e.g., they opened up a new market segment or new customer groups. Differentiation of the offered services means for instance additional offers or changed service hours. On the basis of these two variables, a dummy variable is created, which takes the value one if at least one of the two types of innovation, broadening or differentiation of services offered, has taken place in the last twelve months. This dummy variable represents innovation and is the dependent variable of the empirical analysis. Almost half of the firms were innovative, as Table 1 shows. About 50 percent of the firms made at least one of the two changes with regard to their range of offered services. About 39 percent of the firms broadened and about 34 percent differentiated the range of services offered.

The applications named social software are a rather new phenomenon and are often referred to as web 2.0 applications. That is why the firms were offered a list of applications and were asked if they used them instead of being asked questions about the use of social software in general. Hence, the variable representing the use of social software is a

Table 1: Descriptive Statistics: Innovative Activity

variable	percentage of firms	number of observations
broadening of offered services	39.21	505
differentiation of offered services	34.21	494
at least one innovation	49.90	505

Source: ZEW Quarterly business survey among service providers of the information society, own calculations.

dummy variable which takes the value one if at least one of the following applications were used: blogs, wikis, discussion forums, online communities, teamwork platforms and other applications. This dummy variable represents the main explanatory variable of the empirical analysis. Table 2 shows descriptive statistics of the usage behaviour of the firms concerning social software. About 35 percent of the firms use at least one of the above mentioned applications. The most frequently used applications are online communities, also known as social networks. About 19 percent of the firms use online communities. Teamwork platforms ranked second and are utilised by about 16 percent of the firms. About 13 percent of the firms use discussion forums or wikis. Blogs and other applications play a minor role for the firms in the sample. About seven percent of the firms use blogs and about three percent apply other social software. These descriptive numbers indicate that social software is rather applied for communication and cooperation purposes, as applications which serve these aims are favoured.

Table 2: Descriptive Statistics: Use of Social Software

variable	percentage of firms	number of observations
online community	18.70	492
teamwork platform	15.96	495
discussion forum	13.43	484
wikis	13.11	488
blogs	7.20	486
other social software appl.	3.32	482
at least one social software appl.	35.05	505

Source: ZEW Quarterly business survey among service providers of the information society, own calculations.

This indirect inference is supported by what the firms said the purpose of the social software use is (see Table 3). About 55 percent of the firms that apply at least one social software use it for internal communication and about 49 percent for internal knowledge exchange. The second most important purpose of social software use is external communication and, close to that, customer relationship support. About 38 percent of the firms

use social software for external communication and about 35 percent use it for building and supporting customer relationships. Social software aiming at stimulating innovation and increasing the efficiency of business processes is applied by about 31 and 32 percent, respectively. Social software plays a minor role with regard to work on joint projects, advertisement for new products and other purposes. About 25 percent of the firms apply social software for joint projects, about eleven percent advertise for new products with social software and only about one percent of the firms use social software for other purposes.

Table 3: Descriptive Statistics: Purpose of Social Software Use

variable	percentage of firms	number of observations
internal communication	55.37	177
internal knowledge exchange	49.15	177
external communication	37.85	177
composition and support of customer relationships	35.03	177
more efficient business processes	32.20	177
innovation stimulation	31.07	177
work on joint project with other firms or freelancers	24.86	177
advertisement for new products	11.30	177
other purposes	1.13	177

Only firms which use at least one social software application. Source: ZEW Quarterly business survey among service providers of the information society, own calculations.

Most of the firms use social software for internal as well as for external purposes. Internal purposes are internal communication, internal knowledge exchange, more efficient business processes and innovation stimulation. External communication, composition and support of customer relationships, work on joint projects with other firms or freelancers and advertisement for new products belong to the external purposes. Only about 16 per-

Table 4: Descriptive Statistics: Purpose of Social Software Use, Internal versus External

variable	percentage of firms	number of observations
no social software	67.63	328
social software for internal purposes only	10.10	49
social software for external purposes only	5.57	27
social software for both purposes	16.70	81
sum	100.00	485[a]

Source: ZEW Quarterly business survey among service providers of the information society, own calculations. [a] The reduction of observations to 485 is due to firms indicating that they use social software without answering the question for what purpose or ticking the option "other purposes".

cent of the firms apply social software exclusively for one of both purposes. As Table 4

shows, about 68 percent of the firms do not use social software at all. About ten percent of the firms in the sample use social software for internal purposes only. About five percent use social software exclusively for external purposes. Social software is applied for both purposes by about 17 percent.

4 Analytical Framework and Empirical Strategy

Griliches (1979) introduced the concept of the knowledge production function, which explains the production of new knowledge by the use of specific input factors. Past and current R&D (Griliches 1979), the research activity (e.g. Geroski 1990) or the research intensity and capital, have been seen as main input factors in the knowledge production function, respectively (e.g. Crépon, Duguet, and Mairesse 1998, Griffith, Huergo, Mairesse, and Peters 2006). Knowledge is commonly proxied by innovation output, measured as product or process innovation indicators such as the introduction of new or significantly improved products or processes (Griffith, Huergo, Mairesse, and Peters 2006), patents, innovation counts (Acs, Anselin, and Varga 2002) or the share of innovative sales (Crépon, Duguet, and Mairesse 1998). Thus, the knowledge production function is often referred to as the innovation production function. Recent literature, using the knowledge or innovation production function, focuses not only on R&D indicators but also on other knowledge sources and routes by courtesy of which the ingredients of innovation activity can be obtained.[9] Freel (2006) uses a modified innovation production function where innovation is a function of internally and externally sourced technological competence alongside direct measured firm R&D. In their model of the innovation value chain, Roper, Du, and Love (2008) identify an innovation production function in which knowledge sourcing activities such as in-house R&D, forward linkages to customers, backward links to either suppliers or external consultants, horizontal linkages to either competitors or through joint ventures and linkages to universities or other public research centres constitute an important input. Studies using data of the Community Innovation Survey (CIS) and analysing the innovation activities of manufacturing firms, also employ cooperation variables (e.g. Janz, Lööf, and Peters 2004) or variables representing internal and external sources of knowledge for innovation (e.g. Lööf and Heshmati 2002) to explain innovation behavior.

[9] Love and Roper (1999) use an extended model of innovation activity and identify three main routes by means of which to obtain main ingredients for innovation: R&D, technology transfer (intra-firm phenomenon) and networking (involves inter-firm relationships), which in turn are the main inputs in their innovation production function. Acs, Anselin, and Varga (2002) implement a Cobb-Douglas function with two inputs as their knowledge production function. These two inputs are industry R&D and university research.

Following these newer approaches of the knowledge production framework, I assume the following knowledge or innovation production function:

$$i_i = \alpha + \beta ks_i + \gamma' x_i + \epsilon_i, \qquad i = 1, \ldots, N \text{ firms} \tag{1}$$

where knowledge i_i is proxied by a service innovation indicator. It is a dummy variable which takes the value 1 if the firm has broadened or differentiated its services offered and 0 if the firm did not change its services supply. Due to the binary character of the dependent variable, I estimate a Probit model.[10] The variable ks_i indicates the knowledge sourcing or research activity that is proxied by the dummy variable representing the use of social software and β is the associated coefficient. The coefficient vector γ is associated with the vector x_i including other variables explaining the knowledge production as well as control variables.[11]

The logarithm of the number of employees represents the firm size and the age of the firm is measured in years. Larger firms tend to have more lines of activity and therefore more areas in which they can innovate (Hipp, Tether, and Miles 2000) and larger firm size increases the chances of innovation if there are significant increasing returns to scale in innovation activities (Leiponen 2005, 2006). The relationship between firm age and innovation is not clear (Katila and Shane 2005). On the one hand, organizations might lose their adaptability to their environment with an increasing age and on the other hand, organizational aging might increase innovativeness due to learning processes (Koch and Strotmann 2006).

The competitive situation is reflected by three dummy variables representing the number of main competitors according to the firms' self-assessment: zero to five competitors, six to twenty competitors (reference category) and more than 20 competitors. The relationship between innovation and competition is supposed to look like an inverted U (Aghion, Bloom, Blundell, Griffith, and Howitt 2005). A monopolist has less incentives to innovate because it has a flow of profit that it enjoys and in a competitive situation, there are less incentives to innovate if there is no possibility to fully reap the returns of the innovation (Gilbert 2006). The share of employees working mainly at a PC is a proxy for the IT-intensity of the firm. IT, as general purpose technology (Brynjolfsson and Hitt 2000), and its productive use is closely linked to complementary innovations within firms (Hempell 2005). It can also be used to improve the quality of services (Licht and Moch 1999).

[10] For more details on the Probit model see Wooldridge (2002). All calculations and estimations of this paper were done with STATA 10.0.

[11] Summary statistics of the variables can be found in Table 8 in the Appendix.

The structure of the workforce is represented by three variables accounting for the qualification level and three variables accounting for the age. The shares of highly qualified (university or university of applied sciences degree), medium qualified (technical college degree or vocational qualification) and low qualified (other) employees represent the qualification structure. The share of low qualified employees is the reference category. Qualification is a premise for the starting and enhancements of innovations, because without the suitable know-how neither the introduction nor the execution of innovations can be done successfully. The age structure of the workforce is represented by the share of employees younger than 30 years (reference category), the share of employees aged 30 to 55 years and the share of employees older than 55 years. The age of the employees might have an impact on the firms innovative behaviour for two reasons (Meyer 2008): On the one hand, the process of aging leads to a cutback of fluid intelligence which is needed amongst others for new solutions and a fast processing of information. On the other hand, older workers may resist to innovation when their human capital depreciates.

Former innovations are taken into account for two reasons: Firstly, innovation experience plays an important role in explaining innovative behaviour. Innovating, in particular successful innovating, increases the probability of innovating again (Flaig and Stadler 1994, Peters 2007, Peters 2009). Secondly, there might be an endogeneity problem. On the one hand, it is not clear whether firms that use social software are more innovative or whether innovative firms tend to use new and innovative applications such as social software. On the other hand, social software might not only reflect the knowledge sourcing activity but also a firm's general openness to the use of new technologies and its propensity to change processes. Since the data offers no appropriate instruments to control for this potential endogeneity, former innovations are considered to control for innovativeness and openness to the use of new technologies in general and thus to weaken the endogeneity problem. We have two dummy variables that represent former product and process innovation, respectively.[12] Former product innovation takes on the value one if the firm introduced at least one new or significantly improved service between the third quarter of 2004 and the first quarter of 2007. Former process innovation and thus a general openness to new technologies and changes in the process, takes on the value one if the firm adopted new technologies during this period.

Nine sector dummies are considered to control for industry-specific fixed effects. A dummy variable for East Germany is incorporated to account for potential regional differences. The error term ϵ_i covers all unmeasured (unobserved) influences on knowledge.

[12] In the third quarter of 2005 and first quarter of 2007 the firms were asked "Have you offered a new or significantly improved service during the last twelve months?" (product innovation) and "Have you adopted new or significantly improved technologies (e.g. new data processing systems, Internet) in your company during the last twelve months?" (process innovation).

In a second step, the fact that knowledge can be sourced internally and externally is taken into account. Following Freel (2006) who considers two vectors of internally and externally sourced technological competence, the knowledge or innovation production function is extended in the following way:

$$i_i = \alpha + \beta_1 ksint_i + \beta_2 ksext_i + \gamma' x_i + \epsilon_i, \qquad i = 1, \ldots, N \text{ firms} \tag{2}$$

where $ksint_i$ represents internally sourced knowledge proxied by the use of social software for internal purposes and $ksext_i$ indicates externally sourced knowledge measured by the use of social software for external purposes. All other variables and coefficients stay the same as in equation (1). Since there are only few firms which use social software for exclusively one of the two purposes (see Table 4), four dummy variables are created for the estimation and taken into account: one for no use (reference category), one for exclusively internal purposes, one for exclusively external purposes and one for applying social software for both purposes.

5 Results

Table 5 reports the marginal effects of the Probit estimation of equation (1).[13] The results show that firms which use social software are more likely to innovate than firms which do not use social software. This result is robust across different specifications shown in Table 5. Firms that use social software have a probability of innovating that is about 16.4 percentage points larger than the probability of firms that do not use social software (see last row of Table 5). Since there is no econometric evidence on the adoption of social software and service innovation so far, the results cannot be directly compared to former studies. However, Darroch (2005) finds a positive relation between knowledge management and innovation. The correlation coefficients of the significant knowledge management measures are between 0.13 and 0.27 for innovation types new to the world and between 0.16 and 0.47 for innovation types new to the firm. Darroch and McNaughton (2002) find a positive impact for less than half of their knowledge management measures only. The significant coefficients of their ordinary least squares regression lie between 0.09 and 0.34 and the coefficient of the measure "organisation is flexible and opportunistic" is 0.54 for incremental innovations. Considering the use of social software as a knowledge sourcing tool, the results are in line with the literature that finds a positive relation between internal and, in particular, external knowledge trough cooperation (e.g. Arvanitis and von Arx 2004, Leiponen 2005, Freel 2006, Koch and Strotmann 2006, Leiponen 2006).

[13] Only the average marginal effects (sample averages of the changes in the quantities of interest evaluated for each observations) are discussed in the following. A table containing the coefficient estimates is available upon request.

Table 5: Probit Estimation Results: Average Marginal Effects

dependent variable: dummy for innovation					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
social software	0.162***	0.114**	0.141***	0.141***	0.164**
	(0.046)	(0.047)	(0.049)	(0.053)	(0.068)
firm size		0.075***	0.084***	0.082***	0.059**
		(0.017)	(0.018)	(0.020)	(0.023)
firm age		-0.009***	-0.009***	-0.009***	-0.008**
		(0.002)	(0.002)	(0.003)	(0.003)
IT-intensity			-0.109	-0.147	-0.235*
			(0.085)	(0.096)	(0.123)
competitors 0-5			0.075	0.047	0.031
			(0.058)	(0.061)	(0.073)
competitors >20			0.071	0.063	0.126*
			(0.056)	(0.059)	(0.071)
highly qualified employees				0.322	0.110
				(0.209)	(0.226)
medium qualified employees				0.272	-0.027
				(0.206)	(0.212)
employees 30-55 years				-0.153	-0.074
				(0.141)	(0.179)
employees >55 years				0.299	0.319
				(0.201)	(0.258)
former product innovation					0.255***
					(0.061)
former process innovation					0.122**
					(0.062)
sector dummies		***	**	**	***
regional dummy		-0.058	-0.051	-0.054	-0.052
obs.	505	495	454	415	248
Pseudo R^2	0.02	0.10	0.11	0.12	0.26

Significance levels: $*$: 10% $**$: 5% $***$: 1%. Reference categories: competitors 6-20, unqualified employees, employees $<$ 30 years.

Furthermore, the results reveal that firms which are larger in terms of employment and firms which are younger have a higher propensity to innovate. Literature on firm age and service innovation finds rather no significant impact (e.g. Koch and Strotmann 2006, Peters 2009) or weak evidence for a negative relationship, e.g. Freel (2006), who finds that technology-based knowledge intensive business services between four and nine years old are less likely to innovate than older ones or Rogers (2004), who finds a significantly negative impact of firm age on innovation in non-manufacturing firms only for small firms with less than five employees. The IT intensity of a firm, represented by the share of employees working mainly with a computer, is negatively significant at the ten percent

level but only in the last specification. The competitive situation of a firm has no significant impact apart from specification (5) where the dummy variable for more than 20 competitors is positive at the ten percent significant level. The employees' age and qualification structure and the region East Germany have no significant impact on the probability of innovating. The results in the last row of Table 5 show that firms which have been innovative before are more likely to innovate again.[14] Thereby, the effect of former service product innovation is higher than the effect of former process innovation, that is the adoption of new technologies. Due to an insufficient panel structure, the consideration of former innovations reduces the sample size to 248 observations. All specifications have also been estimated using this small sample. Table 9 in the Appendix contains the marginal effects of these estimations. The results regarding the use of social software did not change qualitatively. However, the dummy variable for more than 20 competitors turns out to be positively significant at the ten percent level.

The potential reverse causality between service innovation and social software use and the problem whether social software measures openness to new technologies and changing processes cannot be solved econometrically due to the lack of appropriate instruments in the data. Nevertheless, since the positive effect of social software use does not diminish when former product innovations are taken into account, the problem of potential reverse causality can be put into perspective. The measurement problem can be relativized as well, since the positive effect of social software use is still there when considering former process innovation, that is the adoption of new technologies and applications. When former product innovations are considered as a proxy for general propensity to be innovative and former process innovations are seen as a proxy for being keen on new applications and technologies, then the results suggest that the causality runs from social software use to service innovation.

Table 6 shows the marginal effects of the Probit estimation considering not only the impact of social software but also whether it is used for internal or external purposes.[15] Compared to firms that do not use social software, firms that use social software for external purposes exclusively are more likely to innovate (see specification (1)). In the second specification, the significance level of this variable drops to ten percent and in specification (3), the variable becomes insignificant. The dummy variable representing social software use for exclusively external purposes is significant at the ten percent level in specification (4) and then again turns insignificant in the last specification. Thus, the

[14] The same regression has also been run, including only the dummy variable for former product innovation, with including only the dummy variable for former process innovations and including only a variable representing at least one of the two. The results did not change qualitatively and are available upon request.

[15] A table containing the coefficient estimates is available upon request.

Table 6: Probit Estimation Results: Marginal Effects intern versus extern

dependent variable: dummy for innovation					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
social software internally	0.106	0.063	0.128	0.119	0.142
	(0.073)	(0.075)	(0.078)	(0.083)	(0.094)
social software externally	0.216**	0.173*	0.150	0.163*	0.150
	(0.088)	(0.090)	(0.094)	(0.139)	(0.141)
social software both	0.208***	0.144**	0.172***	0.168**	0.227***
	(0.058)	(0.062)	(0.063)	(0.069)	(0.085)
firm size		0.073***	0.079***	0.081***	0.058**
		(0.017)	(0.018)	(0.021)	(0.024)
firm age		-0.009***	-0.010***	-0.010***	-0.009***
		(0.002)	(0.002)	(0.003)	(0.003)
IT-intensity			-0.087	-0.126	-0.259**
			(0.087)	(0.098)	(0.125)
competitors 0-5			0.084	0.053	0.032
			(0.059)	(0.062)	(0.075)
competitors >20			0.079	0.067	0.128*
			(0.056)	(0.059)	(0.072)
highly qualified employees				0.371*	0.166
				(0.213)	(0.230)
medium qualified employees				0.315	0.024
				(0.210)	(0.215)
employees 30-55 years				-0.107	0.003
				(0.144)	(0.183)
employees >55 years				0.335	0.381
				(0.204)	(0.266)
former product innovation					0.266***
					(0.063)
former process innovation					0.089
					(0.064)
sector dummies		***	**	*	**
regional dummy		-0.059	-0.049	-0.062	-0.061
obs.	485	475	436	398	237
Pseudo R^2	0.02	0.10	0.12	0.12	0.27

Significance levels: $*$: 10% $**$: 5% $***$: 1%. Reference categories: no social software, competitors 6-20, unqualified employees, employees < 30 years.

results regarding the impact of exclusively externally used social software on innovation are not clear and allow no statement on the impact of exclusively externally used social software on service innovation. This might be due to the data structure and few observations of this variable: Only 27 firms out of 485 claim to use social software exclusively for external purposes (see Table 4). The dummy variable representing social software use for exclusively internal purposes is not significant at all.

To check the robustness, all estimations were done on basis of the smallest sample of 237 observations (specification (5)). Table 10 in the appendix contains the marginal effects of these estimations. The dummy for external social software use is not significant at all whereas the dummy for internal social software use is positively significant at the ten percent level in specifications (1) and (2) and at the five percent level in specifications (3) and (4). In the last specification, the dummy for exclusively internally social software use becomes insignificant. This again might be due to the distribution of the four dummy variables. There are only nine observations left that use social software exclusively for external purposes compared to 25 observations using these applications exclusively internally compared to 39 observations using social software for both.

At first sight, the analysis suggests that the purpose which social software is applied for does not matter, although there is a slight tendency that exclusively externally used social software has a positive impact rather than exclusively internally used social software. That hints to greater importance of external knowledge compared to internal knowledge for service innovation. However, the result is not robust across the different specifications and sample sizes. Using a smaller sample on the other hand suggests the opposite: a greater importance of internally sourced knowledge for service innovation. The reason for these inconsistent results may be due to the data structure and the fact that very few firms use social software exclusively for internal or external purposes. Thus, the analysis does not allow making any statement on the differences between internally and externally used social software and their impact on service innovation.

Furthermore, the results in Table 6 reveal that firms which use social software for internal as well as for external purposes are more likely to innovate compared to firms which do not apply social software. Thus, the general result that firms which use social software are more likely to innovate compared to non-using firms is approved. However, the marginal effect is larger compared to the estimation results in Table **??**. It lies between 0.227 and 0.144, depending on the specification.

Table 6 also approves the findings of Table 5 with regard to firm size, firm age, IT intensity, competitive situation and former product innovation although the effects slightly differ in magnitude. However, there are also differences between the results of the estimation considering social software use in general and the results of the estimation regarding the purpose of social software use: The variable share of highly qualified employees is positively significant at the ten percent level in specification (4) and the dummy variable representing former process innovations is insignificant in Table 6. Latter results are not robust. When assuming that the 20 firms for which there is no statement on the purpose of the social software use are employing social software for both purposes and estimating

all specifications with this variable instead, then the share of highly qualified employees changes to being insignificant in specification (4) and dummy for process innovation changes to being significant.[16]

To summarise the results: ICT and knowledge intensive service firms that use social software are more likely to innovate in terms of broadening and/or differentiation in services supply. The problem of potential reverse causality between social software use and innovativeness cannot be solved econometrically. However, since innovativeness in general, proxied by former innovations, has been controlled for in the estimations, the results suggest a causality that runs from social software to innovation. The problem that social software might not only reflect the knowledge sourcing activity but also a firm's general openness to the use of new technologies and its propensity to change processes, does not weigh that heavy, since taking into account former process innovation to control for a general openness to the use of new technologies, does not change the results regarding the use of social software. The estimation results on the impact of social software used exclusively internally and exclusively externally are ambiguous and not robust across different specifications and sample sizes. Thus, the empirical results do not allow making any statements on whether there are differences in the impact of social software use on service innovation according to their application purpose. However, firms that apply social software for both purposes are more likely to innovate. This, in turn, approves the result on the positive impact of social software use on service innovation.

6 Conclusion

This paper analyses the relationship between the use of social software and service innovation. Social software can be applied for knowledge management and for external communication where it enables access to internal as well as to external knowledge. Knowledge in turn constitutes one of the main inputs to service innovation. Furthermore, this paper tries to identify if there is a difference between the impact of knowledge sourcing activity focusing on external knowledge and focusing on internal knowledge. The analysis refers to a knowledge production function in which the application of social software constitutes the knowledge sourcing activity. The empirical analyses are based on data of about 505 firms in the ICT- and knowledge-intensive business services sector.

The econometric results reveal that there is a positive relationship between the use of social software and service innovation, measured as broadening or differentiation of the range of services offered. Firms applying at least one social software application are more likely to innovate compared to firms which do not use social software. There is an endo-

[16] A table of results is available on request.

geneity problem: On the one hand, it is not clear whether firms that use social software are more innovative or whether innovative firms tend to use new and innovative applications such as social software. On the other hand, social software might not only reflect the knowledge sourcing activity but also a firm's general openness to the use of new technologies and its propensity to change processes. However, since innovativeness in general, proxied by former product innovations, has been controlled for in the estimations, the results suggest a causality that runs from social software to innovation and thus that social software supports service innovation. Considering former process innovation, that is the adoption of new technologies and applications, does not change the results and thus, the measurement problem can be put into perspective.

The estimation results on the impact of exclusively internally and exclusively externally used social software are ambiguous and differ across different specifications and sample sizes. Thus, it is not possible to make any statements on whether there are differences in the impact of social software use on service innovation according to their application purpose. Furthermore, the paper finds that firms which are larger in terms of employment and younger are more likely to innovate. The results also confirm the success breeds success hypothesis, that firms which have been innovative before are more likely to innovate again.

The current analysis sheds light on the relationship between social software and service innovation. However, the question whether social software supports service innovation needs further research. In particular, the question of causality needs to be answered, since with the current data, this problem cannot be solved econometrically and thus, the results only hint at a causality that runs from social software to innovation. Due to few firms indicating that they use social software exclusively for internal or exclusively for external purposes, the variables representing them are insufficient for making a robust and consistent empirical analysis. With a larger and more detailed data set it might be possible to analyse these two channels to add more evidence to the role of internal and external knowledge in service innovation and how to exploit them.

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A Appendix

The ZEW quarterly business survey among service providers of the information society includes the following industries (NACE Rev. 1.1 codes of European Community in parentheses): software and IT services (71.33.0, 72.10.0-72.60.2), ICT-specialised trade (51.43.1, 51.43.3-3.4, 51.84.0, 52.45.2, 52.49.5-9.6), telecommunication services (64.30.1-0.4), tax consultancy and accounting (74.12.1-2.5), management consultancy (74.11.1-1.5, 74.13.1-3.2, 74.14.1-4.2), architecture (74.20.1-0.5), technical consultancy and planning (74.20.5-0.9), research and development (73.10.1-73.20.2) and advertising (74.40.1-0.2). Table 7 shows the distribution across industries in the sample of 505 observations.

Table 7: Distribution of Industries in the Sample

Industry	**Observations**	**Percentage**
software and IT services	80	15.84
ICT-specialised trade	46	9.11
telecommunication services	16	3.17
tax consultancy and accounting	90	17.82
management consultancy	52	10.30
architecture	76	15.05
technical consultancy and planning	44	8.71
research and development	58	11.49
advertising	43	8.51
sum	505	100

Source: ZEW Quarterly business survey among service providers of the information society, own calculations.

Table 8: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
number of employees	67.034	277.485	2	4000	505
log(number of employees)	2.85	1.359	0.693	8.294	505
firm age	16.931	10.349	0	93	495
0-5 competitors	0.286	0.452	0	1	472
6-20 competitors	0.288	0.453	0	1	472
more than 20 competitors	0.426	0.495	0	1	472
share of employees working with PC	0.784	0.295	0	1	493
share of highly qualified employees	0.412	0.307	0	1	476
share of medium qualified employees	0.53	0.299	0	1	476
share of low qualified employees	0.058	0.12	0	1	476
share of employees younger than 30 years	0.198	0.183	0	1	485
share of employees between 30 and 55 years	0.671	0.197	0	1	485
share of employees older than 55 years	0.13	0.144	0	1	485
former product innovation	0.431	0.496	0	1	295
former process innovation	0.416	0.494	0	1	308

Source: ZEW Quarterly business survey among service providers of the information society, own calculations.

Table 9: Probit Estimation Results: Average Marginal Effects, Reduced Sample

dependent variable: dummy for innovation					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
social software	0.222***	0.171**	0.211***	0.200***	0.164**
	(0.064)	(0.067)	(0.068)	(0.069)	(0.068)
firm size		0.073***	0.070***	0.074***	0.059**
		(0.024)	(0.024)	(0.024)	(0.023)
firm age		-0.009***	-0.009***	-0.009***	-0.008**
		(0.003)	(0.003)	(0.003)	(0.003)
IT-intensity			-0.122	-0.211	-0.235*
			(0.116)	(0.132)	(0.123)
competitors 0-5			0.060	0.055	0.031
			(0.078)	(0.077)	(0.073)
competitors >20			0.139*	0.125*	0.126*
			(0.072)	(0.073)	(0.071)
highly qualified employees				0.295	0.110
				(0.241)	(0.227)
medium qualified employees				0.153	-0.027
				(0.225)	(0.212)
employees 30-55 years				-0.145	-0.074
				(0.189)	(0.179)
employees >55 years				0.216	0.319
				(0.271)	(0.258)
former product innovation					0.255***
					(0.061)
former process innovation					0.122**
					(0.062)
sector dummies		***	***	**	***
regional dummies		-0.066	-0.057	-0.073	-0.052
		(0.063)	(0.063)	(0.064)	(0.062)
number of observations	248	248	248	248	248
Pseudo R^2	0.03	0.16	0.17	0.19	0.26

Significance levels : $*$: 10% $**$: 5% $***$: 1%. Reference categories: competitors 6-20, unqualified employees, employees <30 years.

Table 10: Probit Estimation Results: Marginal Effects, intern vs. extern, reduced sample

dependent variable: dummy for innovation					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
social software internally	0.183*	0.178*	0.211**	0.205**	0.142
	(0.095)	(0.094)	(0.092)	(0.091)	(0.094)
social software externally	0.205	0.147	0.204	0.203	0.150
	(0.144)	(0.151)	(0.141)	(0.140)	(0.141)
social software both	0.289***	0.207**	0.256***	0.252***	0.227***
	(0.076)	(0.086)	(0.083)	(0.085)	(0.085)
firm size		0.070***	0.066***	0.072***	0.058**
		(0.025)	(0.025)	(0.025)	(0.024)
firm age		-0.010***	-0.009***	-0.010***	-0.009***
		(0.003)	(0.003)	(0.003)	(0.009)
IT-intensity			-0.139	-0.244*	-0.259**
			(0.118)	(0.134)	(0.125)
competitors 0-5			0.071	0.062	0.032
			(0.079)	(0.079)	(0.075)
competitors >20			0.146**	0.133*	0.128*
			(0.073)	(0.074)	(0.072)
highly qualified employees				0.341	0.166
				(0.243)	(0.230)
medium qualified employees				0.199	0.024
				(0.226)	(0.215)
employees 30-55 years				-0.049	0.002
				(0.194)	(0.183)
employees >55 years				0.293	0.381
				(0.277)	(0.266)
former product innovation					0.266***
					(0.063)
former process innovation					0.089
					(0.064)
sector dummies		**	**	**	**
regional dummy		-0.068	-0.053	-0.078	-0.058
obs.	237	237	237	237	237
Pseudo R^2	0.04	0.16	0.18	0.19	0.27

Significance levels: $*$: 10% $**$: 5% $***$: 1%. Reference categories: no social software, competitors 6-20, unqualified employees, employees < 30 years.