KIND Knowledge Innovation Network
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TELECOM Ecole de Management
Managing through Technology

Paper to be presented at the International Conference on

Organizations, institutions and innovation in the ICT sector: Where do we stand?

Conference organized by Institut-Mines Télécom,
Télécom École de Management
in Paris, 25-26 June 2012

The Adoption of Social Enterprise Software

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Abstract

Though it is still in an infancy state social enterprise software is a highly promising software application for firms. It offers rapid real-time information transfer based on business collaboration tools or instant messaging. The software collects and processes customer data from surveys, consumer feedback, reviews, blogs or social networks. This enables firms to build up detailed customer profiles potentially anticipating upcoming trends. We analyze firm characteristic determinants of social enterprise software adoption. In our analysis, we control for factors like firm size, intensity of information and communication technology, human capital or competitive situation. Exploiting recent granular German firm-level data based on a two step model controlling for sample selection, the results reveal that firms with highly qualified workers, a large share of young employees and international business activity are more likely to adopt social enterprise software. Firms which realized process innovations in the past also have a higher propensity to rely on social enterprise software. In addition, firms belonging to the service sector are more eager to implement social enterprise software applications than manufacturing firms.

Keywords: enterprise software, social software, social enterprise software, technology adoption

JEL Classification: L10, M20, O31

[§] I would like to thank Irene Bertschek, Daniel Cerquera, Francois Laisney, Pierre A. Mohnen and Michael R. Ward for helpful comments and suggestions. All errors are my own

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1 Introduction

In recent years, social software[1] has increasingly appeared in both public conversations and press releases. Moreover, social software is already extensively used in private households and is increasingly adopted by firms. As for firms, more than 80 percent of the top 100 companies in the Fortune 500 maintain a presence on a social network sites (Gartner 2012). Besides social software, a new type of software emerges interrelating recent social software applications and firms' established enterprise systems[2]. These so called social enterprise software links firms' enterprise software systems and social software applications as in social customer relationship management (CRM) solutions[3]. Thereby, it offers a novel and remarkably rapid real-time information transfer, e. g. by combining business collaboration, content sharing and instant messaging into a single, easy-to-use interface[4]. Today, 15 percent of companies engaged in business to business e-commerce already implemented social enterprise software. By 2014, this number is expected to grow up to 70 percent (Gartner 2012).

In a nutshell, social enterprise software supports tracking data from customer surveys, customer feedback, reviews or user profiles on social networks or blogs thereby enabling firms to identify new customers, new market segments and observe recent trends. Besides data tracking and processing social enterprise software packages feature various communication channels allowing for a two-way interaction between the companies and their customers offering the customers a direct channel to provide their feedback. With specific customer data collected and direct customer interaction, social enterprise software might facilitate the development of new products as it allows firms to observe customer tastes and build up meaningful customer profiles. At the moment, social enterprise software is commonly sold by several software vendors. Hence, it is heavily discussed and advertised on internet-video platforms like, e. g., youtube in form of explanatory tutorials[5] or marketing videos[6].

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[1] E. g. wikis, blogs, microblogs or social networks.

[2] E. g. Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Customer Relationship Management (CRM).

[3] Example for such a solution: Oracle Social CRM: http://www.ababj.com/crm/oracle-crm-release-supportsmobile-social-networking.html

[4] Example: Novell Vibe Cloud: http://www.novell.com/products/vibecloud/features/enterprise-social-software.html

[5] For a comprehensive tutorial on social software and social enterprise software executed at Stanford University see http://www.youtube.com/watch?v=9fiEws22b3M.

Up to now there are no empirical studies on this emerging phenomenon although these software packages began to come up in 2008 (Chess Media Group 2010) with Social Customer Relationship Management being the first application followed by first announcements of Social Enterprise Resource Planning at the end of 2008 (Williams 2009). Consequently, as social enterprise software is still an uncertain new technology in its infancy state empirical evidence about determinants and characteristics of the firms which decide to adopt these most recent software applications is still lacking.

We aim at filling this gap by empirically evaluating appropriate determinants and firm characteristics expected to impact the adoption decision. As social enterprise software can be regarded as a new technology or a recent process innovation there are several characteristics expected to influence the implementation decision like the availability of qualified personnel (Wozniak 1987; Lo and Sutthiphisal 2010), size of the firm (Davies 1979; Frambach and Schillewaert 2002), former innovation experience (Flaig and Stadler 1994) or the competitive environment a firm is facing (Bertschek 1995, Aghion et al. 2009). Our analysis is based on a unique database consisting of German manufacturing and service firms. For inference, we rely on a two step estimation approach controlling for sample selection.

In brief, the results reveal that firms with a highly qualified workforce and a large share of young employees are more likely to adopt social enterprise software. Confirming Gartner's (2012) descriptive evidence, firms active in e-commerce are also more likely to employ recent social enterprise software applications. If a firm is active in international business activities like importing it relies more frequently on sophisticated social enterprise systems compared to firms that do not engage in international commerce. Furthermore, if a firm was already successful in the past in terms of innovation activity by realizing process innovations it faces a higher probability of linking enterprise systems and social software. Finally, service firms are more eager to adopt social enterprise software than manufacturing firms. Although hardly surprising in general, our

[6] For a typical generic advertisement of social enterprise software see, e. g., http://www.youtube.com/watch?v=qzNVlODUChg.

results form a solid baseline in explaining social enterprise software adoption which future studies in this field can build on.

The paper proceeds as follows: Section 2 clarifies and disentangles the terms and benefits of enterprise software, social software and social enterprise software. Additionally, section 2 provides a brief overview of the literature focusing on the adoption of new information and communication (ICT) technologies and derives the main hypotheses for the factors we expect to influence the adoption decision. Section 3 presents the dataset whereas section 4 highlights the empirical model and establishes the estimation approach. The estimation results and additional robustness checks to clarify the validity of the results are presented in section 5. Finally, section 6 concludes.

2 Background Discussion

In general, the lines between enterprise and social software and the combination of both software systems are blurry. Hence, we start out this section with an overview of each of the three software applications in detail. Within the overview we shortly highlight the benefits of each software for firms using it.

2.1 Enterprise Software Systems

Enterprise systems are company-wide suites of business software devoted to particular process integration across the value chain. They encompass a wide range of software products supporting day-to-day business operations and decision-making. Widely diffused enterprise systems like Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) serve many industries in numerous areas. To be more precise, ERP systems use a source of data that integrates enterprise functions such as sales and distribution, materials management, production planning, financial accounting, cost control and human resource management. They replace complex interfaces between different systems with standardized cross-functional transaction automation (Aral et al. 2006). An ERP system is expected to reduce order cycle times, which in turn may lead to improved throughput, customer response times and delivery speeds (Cotteleer 2002; McAfee 2002). In contrast, by covering the front office of the firm CRM

systems facilitate the development of medium-term relationships with customers and reduce duplications in data entries due to several unlinked sources by providing the appropriate infrastructure, e. g. enabling effective sales force automation, centralized customer data warehousing and data mining paired with decision support and reporting tools (Katz 2002; Suresh 2004). A CRM system is, moreover, expected to lead to superior customer loyalty, reduced cost of sales and services or improved bottom-line profits (Chen 2001). Empirical evidence confirming positive impacts of enterprise software on several different measures of firm performance is given for example by Aral et al. (2006), Hitt et al. (2002) and Engelstätter (2012).

2.2 Social Software

Social software, on the other hand, encompasses web-based applications which connect people and support communication, interaction and cooperation (e.g. Raabe 2007, Back and Heidecke 2008). In general, such social software applications are wikis, blogs, web forums (discussion forum, internet forum), instant messaging services, social bookmarking, podcasts and social networks sites like e. g. facebook. Within a firm, social software can be applied for different purposes. On the one hand, it can be used to strengthen external communication with other firms and partners or enhance customer relationship management, marketing and market research (Döbler 2007, Raabe 2007). On the other hand, it can be utilized as a knowledge management tool to facilitate internal communication, including for example knowledge and project management or product development. Concerning empirical evidence for the impacts of social software Meyer (2010) shows that service firms experience higher innovation activity if they rely on social software applications.

2.3 Social Enterprise Software

Social enterprise software such as social CRM or social ERP, which links social software applications and firms' enterprise systems is a rather young technology, only a handful of solutions are made available by vendors at the moment. However, the potential impacts of this technology on performance, process or knowledge management seem quite obvious. Once both types of software systems are connected and can share data in realtime, employees participate in a very fast information transfer

as they utilize social software applications like instant messaging which enables them to source all available data as needed directly from the enterprise systems. As connected enterprise systems link business units, connected social and enterprise software can extend communication even more by connecting every employee and providing all data he may require, e. g., customer or sales information. This offers a more central network position to the employees, possibly fostering their innovative activity (Tsai 2001) as they access new knowledge in a faster and better organized fashion. Some software solutions even feature customizable employee profile pages like social online networks which additional help the employees to link themselves and communicate among each other.

Establishing a connection between social and enterprise software seems particularly useful for managing customer relations as a social CRM can directly implement and exploit data and information from customer surveys, commentaries, reviews or user profiles on social networks or blogs. If this data is processed and prepared via social CRM it enables the utilizing firm to monitor recent trends and customer demands ahead of time, helping with the elaboration of sales forecasts and market development expectations. In addition, utilizing this data might also result in new product developments or open up new market segments. Based on the collected data a social CRM system may identify concrete customers for products and services based on the information these potential customers provide on their profiles in social networks. In line with that, a social CRM may also track changes in the profiles thereby easily identifying new possible customers. However, social CRM systems also add value back to the customer as they offer different opportunities for the customer to get in contact and interact with the firm. The customer can choose his preferred communication channel to interact with the company, for instance email, instant messaging, several other chat applications and messages in social networks or blogs. Direct customer feedback and their ideas, needs and wants may also contribute to the development of new products and services, the improvements of current ones or the observation of new trends and purchase intentions (Gartner 2012). In addition, the established two way interaction between the customer and the firm via social CRM might allow engaging non-traditional industry influencers like bloggers, independent analysts and customers passionate

about brands (Chess Media Group 2010) resulting in a positive attitude of the firm's products which might attract even more customers.

2.4 Adoption of New ICT Technologies

In brief, our study is related to literature exploring firm characteristics which impact the decision to adopt most recent ICT technologies. Early work of Baptista (2000) who explores the diffusion and adoption of computer numerically controlled machine tools and microprocessors as a most recent technology reveals that regional learning effects play an important role in the sense that they reduce the time of adoption. Focusing on the adoption of specific ICT practices Bertschek and Fryges (2002) analyze the determinants of business-to-business (B2B) e-commerce implementation in German firms. Their results show that firm size, export activity and the share of highly skilled workers positively impact the firms' decision to utilize B2B. In addition, Bertschek and Fryges (2002) confirm that firms are more likely to implement B2B if other companies within the same industry do so as well. Nevertheless, the empirical evidence in the literature of technology adoption and diffusion based on firm-level analysis is, particularly regarding European countries, somewhat limited. Fabiani et al. (2005) provide an analysis for Italy by analyzing a survey of 1500 Italian manufacturing firms. Focusing on investments in ICT the results of Fabiani et al. (2005) indicate that the most important determinants are firm size, the human capital of the workforce and the presence of large firms in the local environment. ICT adoption also tends to be associated with changes in a firm's organizational structure.

2.4.1 Factors Influencing the Adoption Decision

As discussed among specialists and vendors alike linking social software and enterprise systems by adopting social enterprise software is still merely beginning to embark upon the diffusion process. Accordingly, with the benefits of this software currently not directly measureable due to its rather recent upcoming we set up several hypotheses concerning the factors that are likely to influence the trade-off between potential costs and benefits of adopting this technology. However, as implementing social enterprise software could also be interpreted as an organizational or process innovation,

characteristics influencing the decision to adopt both kinds of innovations should also be of concern. Therefore, as we expect many different firm characteristics to influence the adoption decision to we define several groups of determinants.

First of all, adopting social enterprise software is likely to depend on the size of the company as adopting is more probable for larger firms since these companies can stem the risks and costs of an early adoption more easily (Davies, 1979). On the other hand, Frambach and Schillewaert (2002) expect smaller firms to also adopt new technologies early as these firms might be more flexible and innovative themselves. Nevertheless, larger firms may generally feel more pressure to adopt innovations in order to support and improve their activities and stay competitive (Frambach and Schillewaert, 2002). Given these conflictive predictions we cannot present a clear hypothesis of the impact of firm size on the adoption decision.

The adoption of a new technology might also depend on the presence of international involvement. It seems plausible that companies engaged in foreign activities such as exporting are more likely to use social enterprise software, especially since social CRM facilitates the management of and communication with international contacts due to real-time messaging and planning capabilities. International competition also forces domestic companies to produce as efficiently as possible in order to stay competitive. Bertschek (1995) shows empirically that international competition enhances the individual firm's probability of engaging in product or process innovation. As linking enterprise and social software can be interpreted as a process innovation, the same argument should also hold in this context. Aghion et al. (2009) support this argument as they stress the impact of the competitive environment, measured as new firm entry, on the incentives to adopt innovations. However, they show differences for high tech industries and laggards as industries near to the technological frontier react positive in terms of innovative activity to new firm entry, laggards on the other hand are negatively affected. Given these results we expect firms active in a highly competitive environment to be more likely to adopt social enterprise software compared to firms doing business in areas with low competition.

Wozniak (1987) stresses the impact of human capital, measured by education and experience, on the adoption of a new technology in agriculture and confirms empirically that more educated and experienced farmers are more likely to be early adopters than other farmers. In a more recent study, Lo and Sutthiphisal (2010) support this finding as they show that new technology adoption, measured as electrical technology adoption in the US in general, depends on the availability of appropriate human capital. Spitz-Oener (2006) suggests that the use of new technologies and the diffusion of ICT change the skill requirements and thus lead to an increase in demand for highly qualified labor. However, not only the quality of the workforce impacts the adoption decision as the age structure of the workforce also influences the firms' openness to new technologies. Meyer (2010) confirms this assumption by showing that firms with a higher share of younger employees are more likely to adopt new technologies. Based on these results we expect firms with a high proportion of highly qualified employees or younger employees to have a higher propensity to adopt social enterprise software in contrast to firms without an appropriate human capital base available.

As process and product innovations are often interrelated (Hall et al., 2009) one could expect that product innovation activity impacts the firms' openness towards new technology. This might be especially true in the case of social CRM as product innovations are far easier to handle, categorize or organize if a firm can directly access all results of customer surveys or has a structured list of all customer commentaries at hand. Interpreting the implementation of social enterprise software as process innovation also leads to the success breeds success phenomenon (Flaig and Stadler, 1994; Peters et al. 2009) indicating that former innovation activity positively affects current innovations. Overall, we hypothesize that former innovation activities positively impact the firms' decision to implement social enterprise software.

The decision to implement SES is likely to depend on the firm's ICT intensity which is empirically confirmed by Bertschek and Fryges (2002) for the decision to adopt the formerly new technology B2B e-commerce. For ICT intensity, many different measures, like e. g. the share of workers equipped with a personal computer or the number of networked computer systems, could be used. In our following empirical analysis we

measure ICT intensity with three different variables, i. e. the expenditures for ICT components and staff, established e-commerce practices and ICT outsourcing. In line with Bertschek and Fryges (2002) we hypothesize that ICT intensive firms are more likely to adopt sophisticated social enterprise software applications.

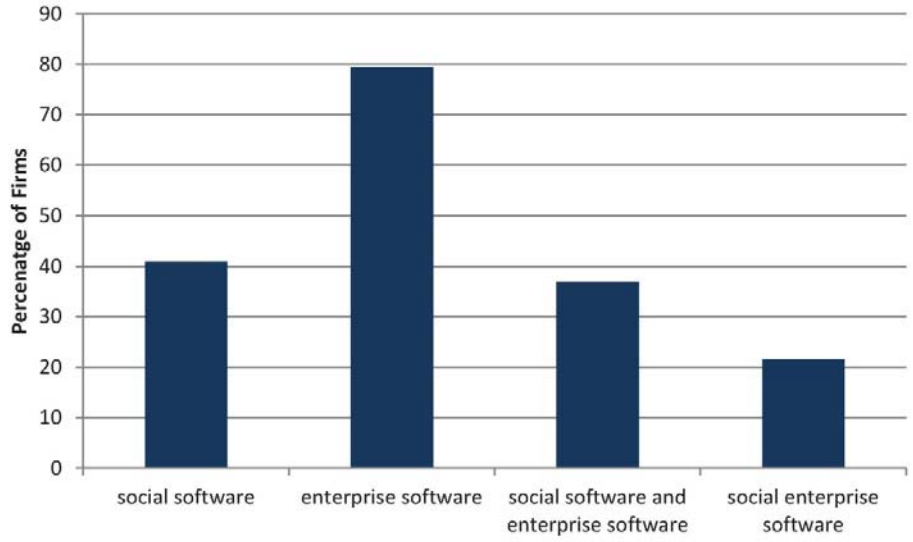
3 Description of Data

The dataset used in this study stems from two computer-aided telephone surveys conducted in 2007 and 2010 by the Centre for European Economic Research (ZEW). These ZEW ICT-surveys lay a specific focus on the diffusion and use of ICT in German companies. In addition, the surveys contain detailed information about the firms' economic characteristics and performance such as the qualification or age structure of the workforce and other variables, e. g. competitive situation, innovation performance, exports and e-commerce. In general, the interviewee was the chief executive officer of the firms who could also decide to pass on questions to a corresponding employee like, e. g., the head of the ICT department. Each wave of this dataset originally contains information of about 4.400 firms with five or more employees, representatively chosen from important service and manufacturing sectors in Germany. The data basis for the sample stems from the credit rating agency Creditreform. This agency provides the largest data base on firms available in Germany. The selection from the population of German firms was stratified according to industries, i. e. seven branches of the manufacturing industry and ten selected service sectors, to five size classes and to two regions, i. e. East and West Germany.

The ZEW ICT surveys are organized as a panel dataset. However, as the questions on the usage of social enterprise software and social software applications were included for the first time in the survey of 2010, a panel data analysis cannot be provided in this paper. Thus, we employ a specific cross-section which consists of a combination of the survey waves conducted in 2010 and 2007 for inference. Combining these two surveys is necessary as we need a well defined temporal sequence between the usage of social enterprise software and the appropriate exogenous variables. We explain the selection of variables in detail in the following section.

For this study, we construct a dummy variable for the usage of social enterprise software which takes the value one if a firm establishes a link between its enterprise systems in use and its employed social software applications in the year 2010 and zero otherwise. Establishing such a link needs to be interpreted as adopting social enterprise software as this software is the only tool that enables firms to link both types of software. This dummy variable, i. e. using social enterprise software, represents the dependent variable in our analysis. The descriptive statistics in Table 1 show that more than 20 percent of the firms use social enterprise software. However, to employ social enterprise software firms need to adopt enterprise systems and social software first. In order to analyze the usage of social enterprise software, we accordingly built three dummy variables for the usage of social software applications, the usage of enterprise software systems and the usage of both social software and enterprise software in the year 2010. The dummy variable representing the use of social software applications takes the value one if at least one social software application such as a blog, wiki, social network, collaboration platform, podcast or RSS-feed is used in the year 2010. Figure 1 shows that at least one social software application is employed by about 40 percent of the firms. The dummy variable for the usage of enterprise software systems, on the other hand, takes the value one if a firm uses at least one of the enterprise software systems ERP, SCM or CRM and zero otherwise. About three quarters of the firms use at least one of the mentioned enterprise software applications, see figure 1. Furthermore, figure 4 indicates that about one third of the firms employ at least one type of social software and one enterprise software application. About 60 percent of the firms using enterprise software and social software link both software applications with each other.

Figure 1: Usage of Software Applications



Source: ZEW ICT Survey 2010, own calculations, 1523 observations, descriptive statistics

4 Analytical Framework and Estimation Procedure

Due to the fact that in our dataset only firms who use at least one social software application and at least one enterprise software application are able to link both software types we face a selection problem in our analysis. Hence, the decision to adopt social enterprise software has to be split up into two parts. First, firms have to decide about using both social software and enterprise software applications. The second part of the decision process then refers to whether firms link their social software applications with their enterprise software systems. Both decisions depend on several heterogeneous firm characteristics that we include in our model. Due to this sample selection problem resulting in a two stage decision process we use the Heckman selection model (Heckman 1979) for inference in our empirical analysis. The first part of the decision process is modeled by the selection equation

$$ES_i^* = X_i\beta_1 + ID_i\beta_2 + Z_i\beta_3 + \epsilon_i \qquad ES_i = 1 \text{ if } ES_i^* \geq 0;\ ES_i = 0 \text{ otherwise} \qquad (1)$$

With ES_i^* being a latent variable reflecting both the use of social software applications and enterprise software for firm *i*. Both types of software applications are used by firm *i* but not linked with each other at this point of time. X_i contains firm characteristics expected to influence the decision of firm *i* to use social software and enterprise software, i. e. firm size, qualification structure of the workforce, age structure of the workforce, e-commerce, competitive situation, exports, imports, innovation activity, ICT outsourcing and expenditures for ICT components and staff as argued in section 2. ID_i includes common control dummies for business sector and East Germany. Z_i reflects the exclusion restriction we use in our analysis which we explain in detail in the next section. We assume a standard identically distributed error term.

As the selection equation (1) shows which firm characteristics foster the unlinked use of social software applications and enterprise software, the next consecutive step will be to reveal the firm characteristics that lead to the linkage of social software and enterprise software, i.e. adopting SES. We model the second part of the decision process being the outcome equation as

$$SES_i^* = X_i\gamma_1 + ID_i\gamma_2 + u_i \qquad SES_i = 1 \text{ if } SES_i^* \geq 0;\ SES_i^* = 0 \text{ otherwise} \qquad (2)$$

where SES_i^* is the unobserved latent variable accounting for the usage of social enterprise software for firm *i*. In the outcome equation, we use the same explanatory variables X_i as in the selection equation without the mentioned exclusion restriction. u_i is again a standard identically distributed error term. Equations (1) and (2) are estimated via maximum likelihood. As ES_i and SES_i are both dummy variables we use a bivariate probit with sample selection (Berinsky 2004, Gourieroux and Jasiak 2007) as estimation procedure for the Heckman selection model. The employed explanatory variables as well as the exclusion restriction and their temporal sequence are explained in detail in the following.

4.1 Selection of exogenous variables

Starting out with the explanatory variables, we control for firm size by the logarithm of the number of employees measured in the year 2009. We also consider the qualification structure of the workforce by creating three control variables: the share of highly qualified (university or university of applied science degree), medium qualified (technical college or vocational qualification) and low qualified (other) employees measured in the year 2009. The share of low qualified employees is taken as the reference category. Three variables control for the age structure of the employees. The first one represents the share of employees younger than 30 years, the second one the share of employees between 30 and 50 years (reference category) and the third one the share of employees over 50 years. The age structure of employees was measured in the year 2009. In addition to firm size as well as age and qualification structure of the work force we also control for a works council which often established in German firms. Such a council enables employees to participate in decision making (Zwick 2003) like, e. g., the decision to adopt huge sophisticated software applications. Accordingly, as an established works council influences firm decisions it forms a proxy for firm strategies and perspectives.

The usage of e-commerce is measured by a dummy variable taking the value one if a firm applies either business-to-business or business-to-consumer e-commerce. Both e-commerce applications were measured in the year 2010. As the competitive situation is another relevant issue for the usage of social enterprise software we employed three dummy variables capturing the number of main competitors in the year 2009 according to the firms' self-assessment. The first one includes zero to five competitors, the second one six to 50 competitors which is our reference category and the last one more than 50 competitors. As for international business activity we measure the export activity of firms by creating a dummy variable that takes the value one if the firms exported goods or services during the year 2009. The firms' import activity is measured analogously as a dummy variable taking the value one if the firms imported goods or services during the year 2009 and zero otherwise.

We control for former innovation activity with two specific dummy variables. Each takes the value one if a firm realized at least one product or process innovation during 2004 to 2007 and zero if no type of innovation was realized. ICT outsourcing is measured by the share of ICT expenditures allotted to external service providers during the year 2009. We further proxy firms' ICT intensity by including expenditures for both ICT components and staff per employee in the year 2009 in our analysis. For practical reasons we employ the logarithm of these expenditures in our empirical analysis. In addition, we use a dummy variable to control for business sector specific fixed effects. This dummy variable takes the value one if a firm belongs to the service sector and zero for manufacturing firms. Although, finer grained industry classification of the firms is available we decided against using the classifications in our estimates. We cover these classifications in more detail in a robustness check. A dummy variable for East Germany accounts for potential regional differences.

4.2 Exclusion restriction

As an appropriate exclusion restriction we need an explanatory which highly correlated with the selection variable but features no correlation to social enterprise software adoption. The exclusion restriction we use is ICT training measured as the share of employees who received specific ICT-related training in the year 2006. We expect this exclusion restriction to be correlated with the common use of social software and enterprise software but showing no correlation with the linkage of both software types. Firms engaging in ICT training in the year 2006 might do so to get first insights into the use of social software applications and possibly prepare the use of these software applications at a later point in time. Social software applications were a new technology in the year 2006 especially for private users and not yet broadly applied by firms. Thus, ICT training is necessary for the adoption of social software applications by firms. The adoption of new enterprise software systems in firms usually also requires ICT training as these systems are sophisticated and it is hardly possible to adopt and use them properly without appropriate training. First solutions of social enterprise software systems, however, arose in the year 2008 for the first time. Accordingly we can exclude the possibility that social enterprise software may be part of the ICT training measures conducted by the firms in 2006. As due to this timing argument we conclude that our ICT

training measure is not correlated to the adoption decision it forms suitable exclusion restriction in our empirical setup. For an overview, Table 1 pictures the summary statistics for all variables, including endogenous and exogenous variables as well as the exclusion restriction.

Table 1: Summary Statistics

Variable	Mean	Min.	Max.	N
social enterprise software	0.216	0	1	1523
enterprise software		0	1	1516
social software		0	1	1458
social software and enterprise software		0	1	1521
number of employees		1	45000	1523
log (number of employees)		0	10.714	1523
share of highly qualified employees		0	1	1408
share of medium qualified employees		0	1	1406
share of low qualified employees		0	1	1413
share of employees younger than 30 years		0	1	1415
share of employees between than 30 and 50 years		0	1	1420
share of employees older than 50 years		0	1	1425
0-5 competitors		0	1	1523
6-50 competitors		0	1	1523
more than 50 competitors		0	1	1523
exports		0	1	1519
imports		0	1	1514
former product innovation	0.557	0	1	1505
former process innovation	0.632	0	1	1510
ICT outsourcing		0	1	1183
ICT expenditures per employee		1	300000	1195
log (ICT expenditures per employee)		-5.480	12.611	1195
works council	0.313	0	1	1523
service sector		0	1	1523
East Germany		0	1	1523
ICT training 2006		0	1	1458

Source: ZEW ICT Survey 2007, 2010 and own calculations.

5 Results

5.1 Main Results

Table contains our main estimation results picturing the selection equation (1) and the outcome equation (2) in two different specifications. In the first model specification we estimate the model with a parsimonious set of baseline variables representing some firm characteristics like firm size, qualification and age structure of the workforce, the competitive situation and the application of e-commerce. In the second specification of Table we augment the baseline specification with the variables exports, imports, former innovation activity, ICT outsourcing, ICT expenditures per employee, works council as well as business sector and regional dummies. In general, the model is precisely estimated as the selection parameter Rho is significant in both specifications. As for the exclusion restriction, the coefficient estimate of ICT training is positive and also highly significant in both specifications.

Comparing the implementation of enterprise systems and social software pictured in the selection equation and the adoption of social enterprise software in the adoption equation an eminent difference seems to manifest in the characteristics of the workforce. Whereas in the selection equation the need for highly qualified workers dominates in both specifications a large proposition of younger workers fosters the adoption of social enterprise software. With social enterprise software being a very recent phenomenon workers being digital natives up to 30 years old might exhibit learning advantages as they, in general, are used to several aspects of social enterprise software like the communication tools and social network sites. However, a similar argument should also hold for firms' adoption of simple social software, as digital native workers might be used to such software applications as they can be expected to employ social software in private. Nevertheless, social software is already widely diffused and known resulting in the impact of the younger workforce on its adoption to mitigated and not significant as our results confirm.

Table 2: Bivariate Probit with Sample Selection: Coefficients Estimates

	Specification 1		Specification 2	
	Selection Equation	**Outcome Equation**	**Selection Equation**	**Outcome Equation**
ln firm size	0.294***	0.061	0.274***	0.076
	(0.035)	(0.073)	(0.041)	(0.087)
share of highly qualified	1.314***	0.552	1.290***	0.817*
employees	(0.224)	(0.440)	(0.267)	(0.427)
share of medium qualified	0.156	-0.084	0.265	0.137
employees	(0.219)	(0.371)	(0.251)	(0.373)
employees < 30 years	0.256	0.801*	0.244	0.918**
	(0.234)	(0.341)	(0.271)	(0.413)
employees > 50 years	-0.146	0.106	0.015	0.140
	(0.223)	(0.352)	(0.256)	(0.354)
e-commerce	0.571***	0.552***	0.515***	0.446***
	(0.079)	(0.125)	(0.091)	(0.127)
competitors 0-5	-0.115	0.076	-0.200*	0.074
	(0.091)	(0.129)	(0.103)	(0.155)
competitors >50	-0.043	-0.001	0.031	-0.028
	(0.106)	(0.154)	(0.120)	(0.161)
works Council	-0.065	0.259	-0.177	0.219
	(0.109)	(0.158)	(0.123)	(0.207)
exports	-	-	0.119	0.056
			(0.109)	(0.140)
imports	-	-	0.198*	0.247*
			(0.103)	(0.127)
former product innovations	-	-	0.143	-0.011
			(0.099)	(0.147)
former process innovations	-	-	0.355***	0.256*
			(0.098)	(0.145)
ICT outsourcing	-	-	-0.271*	-0.005
			(0.149)	(0.228)
ICT expenditures per employee	-	-	0.077***	0.036
			(0.023)	(0.035)
service sector dummy			0.190*	0.328**
			(0.109)	(0.149)
region dummy			-0.088	-0.085
			(0.096)	(0.127)

constant	-2.203***	-1.342*	-2.597***	-2.281***
	(0.248)	(0.694)	(0.312)	(0.729)
exclusion restriction:	0.847***	-	0.502**	-
ICT Training 2006	(0.174)		(0.220)	
Rho	0.606 (0.274)		0.803(0.294)	
LR-Test (Rho=0)	3.02*		3.05*	
# of obs. (cens/uncensored)	1306 (850/456)		1047 (675/372)	

Notes: *** p<0.01, ** p<0.05, * p<0.1; standard errors in parentheses.
Reference categories: competitors 6-20, least qualified employees, Employees 30-50 years.
Source: ZEW ICT survey 2007, 2010 and own calculations.

Overall, all significant coefficients in the main regression result in significant marginal effects which we picture in Table . Starting out with specification (1) the results show that larger firms are significantly more likely to adopt social enterprise software. Furthermore, we observe that firms with a higher share of younger employees face a significantly higher probability to link their enterprise systems with social software applications. This result stays in line with our hypothesis derived in section 2 of this paper. The effects of the share of younger employees as well as e-commerce do not change qualitatively via including the mentioned additional variables in specification (2) to control for unobserved heterogeneity. Firm size, however, fails to impact the adoption decision in the second specification. Accordingly, we expect the impact of firm size in specification (1) to be upwardly biased due to the lack of sufficient control variables. Unexpectedly, firms with a high share of highly qualified employees are significantly more likely to adopt social enterprise software in specification (2). This result could point towards some sort of multicollinearity in the model specification as it is not in line with the results of specification (1). Nevertheless, as most other coefficients do not change qualitatively in specification (2) and the overestimated size effect in specification (1) might also mask the impact of a qualified workforce in that specification we refrain from a potential multicollinearity issue in the case.

The usage of e-commerce practices is related to a significantly higher probability of adopting social enterprise software by about 13 percentage points compared to firms which do not employ e-commerce applications confirming our expectations. However,

contrary to our expectations other measures of ICT intensity like ICT outsourcing and ICT expenditures fail to impact the adoption decision.

As hypothesized in section 2 of this study firms that import goods or services are significantly more likely to adopt social enterprise software than firms without any importing activity. The impact of imports upon the firms' decision to adopt social enterprise software is about 7 percentage points. Contrary to international business activity and our hypotheses formed before the competitive situation is no significant driver of social enterprise software.

Controlling for the "success breeds success" phenomenon our results confirm that firms who have already realized process innovations in the past have a higher probability to use social enterprise software. In detail, the probability of linking social software with enterprise software is about 7 percentage points higher for past process innovators than for non-innovative firms. Moreover, the results reveal that firms being part of the service sector face a 9 percentage points significantly higher probability to use social enterprise software compared to firms belonging to the manufacturing sector.

Table 3: Bivariate Probit with Sample Selection: Average Marginal Effects

dependent variable: dummy for social enterprise software

	(1)	(2)
log. firm size	0.020	0.021
	(0.021)	(0.020)
highly qualified employees	0.179	0.226**
	(0.125)	(0.100)
medium qualified employees	-0.027	0.038
	(0.121)	(0.103)
employees < 30	0.260**	0.254*
	(0.122)	(0.150)
employees > 50	0.035	0.039
	(0.116)	(0.100)
e-commerce	0.188***	0.128***
	(0.039)	(0.036)
competitors 0 - 5	0.025	0.021
	(0.043)	(0.046)
competitors > 50	-0.000	-0.008
	(0.050)	(0.044)
works council	0.087	0.063
	(0.060)	(0.071)
exports		0.015
		(0.039)
imports		0.070*
		(0.038)
former product innovation		-0.003
		(0.041)
former process innovation		0.070**
		(0.035)
ICT outsourcing		-0.002
		(0.063)
ICT expenditures per employee		0.020
		(0.009)
service sector dummy		0.091*
		(0.049)
region dummy		-0.023
		(0.035)
observations	1306	1047

Significance levels: *:10%, **:5%, ***:1%. Reference categories: competitors 6-50,

unqualified employees, employees 30-50 years. Source: ZEW ICT survey 2007, 2010 and own calculations.

5.2 Robustness Checks[7]

To validate the robustness of our result we conduct to different checks. For the first robustness check we address the industry fixed effects. As in our main specification (2) we simply control for manufacturing and services we also run the regressions introducing all seventeen industry classifications listed in Table separately in the estimation. Overall, all industry coefficients turned out to be insignificant with the overall model being less precisely estimated. Additionally, we could not deny the hypothesis that all industry dummies have the same coefficient. Accordingly, as the additional information gained from adding the detailed industry controls seems small as we cannot identify industry specific influences on the decision to adopt social enterprise software we decided to refrain from including all industry classifications in our regression and aggregated them to a business sector dummy.

[7] The results of the robustness checks are available from the authors upon request.

Table 4: Distribution of Industries in the Sample

Industry	Observations	Percentage
Consumer goods	129	8.47
Chemical industry	73	4.79
Other raw materials	89	5.84
Metal and machine construction	103	6.76
Electrical engineering	172	11.29
Precision instruments	93	6.11
Automobile	68	4.46
Wholesale trade	93	6.11
Retail trade	79	5.19
Transportation and postal serv.	117	7.68
Banks and insurances	39	2.56
Computer and telecommunication services	140	9.19
Technical services	95	6.24
Real estate and leasing services	37	2.43
Management consultancy and advertising	42	2.76
Media services	118	7.75
Services for enterprises	36	2.36
sum	1523	100

Source: ZEW ICT-Survey 2007,2010 and own calculations.

To control for unobserved heterogeneity we also add additional explanatory variables which might impact the adoption of social enterprise software to our estimations. In detail, we control for a subsidiary of firms in foreign countries and firms being part of a corporation. In both cases the adoption of social enterprise software could facilitate and enhance the communication and knowledge transfer between subsidiaries. Both variables were collected in the survey wave of 2007. However, both coefficients turn out

be insignificant and including both variables does not change the results obtained in any way.

6 Conclusion

Besides the widely established enterprise software systems and social software applications a new recent phenomenon starts to catch the attention of firms and institutions alike, namely social enterprise software. This specific software is expected to offer several benefits in information storing and handling, knowledge acquisition, management and customer relations (Chess Media Group 2010). As social enterprise software is a very recent and new technology at the beginning of its diffusion process, potential benefits and problems are not sufficiently analyzed and explored yet in economic literature. Determinants influencing the decision to adopt social enterprise software still remain to be investigated.

In our current study we aim at filling this gap by empirically exploring the impact of several heterogeneous firm characteristics on the firms' decision to adopt social enterprise software. Based on a German ICT firm dataset the results confirm that firms with a highly qualified workforce and a large share of young employees are more likely to adopt social enterprise software. More ICT intensive firms like e-commerce users are also more open towards social enterprise software implementation. Firms active in international business activities, like importing, rely more frequently on linking enterprise and social software than firms not engaged in international business. Having already successfully established process innovations in the past also results in a higher probability to employ social enterprise software. Furthermore, firms in the service sector are more eager to adopt social enterprise software as firms active in the manufacturing sector.

Besides offering insights for potential influences on the firms' decision to implement social enterprise software the results of our study also have several practical implications for customers and vendors of social enterprise software. Starting out with customers who are interested in the requirements of these recent software applications it seems that the usage of social enterprise software is indeed dependent on a

sufficiently qualified and young ICT affine workforce. Also experience gained out of establishing process innovations like motivating reluctant employees to adopt the innovation seems to be helpful for firms planning to use social enterprise software applications.

For vendors, it seems obvious to focus on enhancing and improving the key features customers value the most, to boost customer satisfaction and thereby maybe realize rising sales. Based on the results obtained, these key features are the improved usage of e-commerce and international business activities. Vendors might also consider focusing on the manufacturing sector, maybe building up sector specific social software applications. As the manufacturing sector seems still reluctant to adopt social enterprise software such a focus based on sector specific or even customizable software applications might open up new market segments. For the service sector recent applications seem already quite successful. As firms only consider linking enterprise systems and social software if they can rely on sufficient human capital, it may be the case that the skill and knowledge barriers firms have to cross in order to utilize social enterprise software might be too high. Accordingly, vendors should mitigate this burden, maybe with enhanced step-by-step tutorials or very intuitive interfaces.

Our analysis faces a few potential short-comings which are primarily related to data constraints and unobserved heterogeneity in general. Besides the proxy of an established works council we do not observe management decisions of the surveyed firms. It may be the case that some firms simply adopt new technologies because they want to be on the fast lane in terms of technology, sending out a positive signal. However, a part of this phenomenon is captured in the ICT expenditures we control for as those firms can be expected to spend more money on ICT compared to firms which are not as oriented towards the technology frontier. Availability of new data might take care of these potential drawbacks, accordingly we pass this issues on to further research. Overall, our exclusion restriction is not without concern about its exogeneity. It may be the case that ICT intensive firms invest more in ICT training and expect their trained employees to adopt and utilize social enterprise software more eagerly. As social enterprise software solutions are sophisticated software tools, even more eager

employees might not be able to utilize the software to its full potential without specific training. As such training and further education is definitely not captured in our exclusion restriction general ICT training, we expect the mentioned eagerness to produce an endogeneity bias of negligible size.

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