Ohnemus, Jörg

Working Paper

IT outsourcing and employment growth at the firm level

ZEW Discussion Papers, No. 10-108

Provided in cooperation with:
Zentrum für Europäische Wirtschaftsforschung (ZEW)

Suggested citation: Ohnemus, Jörg (2010) : IT outsourcing and employment growth at the firm level, ZEW Discussion Papers, No. 10-108, http://hdl.handle.net/10419/44451

Discussion Paper No. 10-108

IT Outsourcing and Employment Growth at the Firm Level

Jörg Ohnemus

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

Discussion Paper No. 10-108

IT Outsourcing and Employment Growth at the Firm Level

Jörg Ohnemus

Non-Technical Summary

In the short run, outsourcing is usually associated with the resulting job losses in the contract granting firm, since in-house staff is generally laid-off or transferred to the outsourcing provider. However, the medium and long run effects of outsourcing on employment growth might still be positive. As recent research has revealed, outsourcing can lead to substantial improvements in firm performance which may in turn result in competitive advantages for these firms. A stronger market position boosts additional demand for the products and services offered by outsourcing firms which thereby eventually enables them to raise employment in order to satisfy this positive demand shift.

This paper analyses the outsourcing of information technologies (IT) and its effect on medium-term subsequent firm-level employment growth in Germany. IT outsourcing is a special case of outsourcing and it can be seen as the practice of turning over all or at least parts of an organisation's IT functions to an outside vendor. Recently assembled representative results for Germany indicate that more than 78 percent of firms with five or more employees are involved in IT outsourcing. During the last decade, the latter has beyond doubt become an integral part of corporate strategy for German firms.

The data stems from the ZEW ICT surveys conducted in 2004 and 2007 in the German manufacturing and selected service industries. More than 1 100 observations are available for the empirical analysis. Firm growth refers to the period from 2003 to 2006 and is based on the (firm-level) employment figures measured for both time periods. IT outsourcing describes whether the firm has outsourced at least one of the following three basic IT services to an external service provider: installation of hard- and software, computer system maintenance, user assistance and support. Due to the fact that IT outsourcing firms may also be the ones that are more successful in general, for instance due to unobservable firm characteristics such as managerial abilities, this study takes account of endogeneity by employing a two stage instrumental variable approach.

The study finds evidence that IT outsourcing has a positive effect on firms' employment growth rate. Dividing the sample into manufacturing and service firms, however, a medium-term positive growth effect of IT outsourcing can only be observed for firms operating in the service sector.

Das Wichtigste in Kürze

In der Regel assoziiert man mit Outsourcing, zumindest auf kurze Sicht, den Abbau von Arbeitsplätzen in den auslagernden Unternehmen. Bisher mit den auszulagernden Aufgaben betraute Mitarbeiter werden entweder entlassen oder an den Outsourcing-Anbieter transferiert. Mittel- und langfristig allerdings kann sich Outsourcing auch positiv auf die Beschäftigung auswirken. Neuere Untersuchungen haben gezeigt, dass Outsourcing erheblich zum Unternehmenserfolg beitragen kann, was dem auslagernden Unternehmen einen Wettbewerbsvorteil gegenüber der Konkurenz verschafft. Eine stärkere Marktposition fördert wiederum die Nachfrage nach den Produkten und Dienstleistungen des auslagernden Unternehmens, was im Endeffekt zu einem Anstieg der Beschäftigung führt, um diese positive Nachfrageverschiebung zu befriedigen.

Die vorliegende Arbeit befasst sich mit den Auswirkungen der Auslagerung von Informationstechnologien (IT) auf das mittelfristige Beschäftigungswachstum von Unternehmen in Deutschland. IT-Outsourcing ist eine spezielle Art der Auslagerung, bei der ein Unternehmen seine gesamten IT-Funktionen (oder zumindest Teile davon) von einem externen Anbieter erledigen lässt. Aktuelle repräsentative Umfrageergebnisse für Deutschland zeigen, dass mehr als 78 Prozent der Unternehmen mit fünf und mehr Beschäftigten IT-Outsourcing in Anspruch nehmen. Während des letzten Jahrzehnts ist IT-Outsourcing zu einem integralen Bestandteil der Unternehmensstrategie für deutsche Unternehmen geworden.

Die vorliegende Untersuchung basiert auf einer Stichprobe von rund 1 100 Firmen aus dem verarbeitenden Gewerbe und aus ausgewählten Dienstleistungsbranchen in Deutschland. Datengrundlage hierfür ist die ZEW IKT-Umfrage aus den Jahren 2004 und 2007. Unternehmenswachstum bezieht sich auf den Zeitraum 2003 bis 2006 und basiert auf den (auf Unternehmensebene erhobenen) Beschäftigtenzahlen zu beiden Zeitpunkten. Eine Firma wird zur Gruppe der auslagernden Unternehmen gezählt, sobald sie mindestens einen der folgenden drei grundlegenden IT-Dienste an einen externen Dienstleister ausgelagert hat: Installation von Hard- und Software, Systembetreuung und Wartung oder Anwenderunterstützung. Um der Tatsache Rechnung zu tragen, dass gegebenenfalls gerade erfolgreiche Unternehmen eher IT-Outsourcing betreiben, z.B. weil sie über bessere Managementfähigkeiten verfügen, kommt bei der empirischen Analyse ein Instrumentvariablenansatz zum Einsatz.

Als zentrales Ergebnis findet diese Untersuchung Evidenz dafür, dass IT-Outsourcing mittelfristig einen signifikant positiven Effekt auf das Beschäftigungswachstum auf Unternehmensebene hat. Differenziert man allerdings zwischen Unternehmen aus dem verarbeitenden Gewerbe und Dienstleistungsunternehmen, zeigt sich ein ein positiver Beschäftigungseffekt von IT-Outsourcing nur für Unternehmen im Dienstleistungssektor.

IT Outsourcing and Employment Growth at the Firm Level*

Jörg Ohnemus†

Centre for European Economic Research (ZEW), Mannheim

December 27, 2010

Abstract

Outsourcing is widely associated with accompanied job losses in the outsourcing firm, at least in the short run. However, the medium and long run effects of outsourcing on employment growth might still be positive. This paper particularly focuses on IT outsourcing and its medium-term effects on employment growth. Therefore, a three year time period from 2003 to 2006 is analysed using German firm-level data and instrumental variable estimation. I find evidence that IT outsourcing has a positive effect on firms' employment growth rate. However, dividing the sample into manufacturing and service firms, a medium-term positive growth effect of IT outsourcing can only be observed for firms operating in the service sector.

Keywords: Information and Communication Technology, Outsourcing, Employment Growth

JEL-Classification: L86, L24, L25, J21,

* Financial support by the Landesstiftung Baden-Württemberg foundation is gratefully acknowledged.

† Centre for European Economic Research (ZEW), Research Group Information and Communication Technologies, P.O. Box 10 34 43, D–68034 Mannheim, Germany, Tel.: +49–(0)621–1235–354, Fax: +49–(0)621–1235–4354, ohnemus@zew.de.

1 Introduction

Outsourcing is commonly not associated with employment growth at all. In public opinion, rather the opposite is the case, where people usually associate job cuts through outsourcing. However, as recent research has shown (e.g. Amiti and Wei, 2009; Han et al., 2010; Wang et al., 2008), outsourcing can also lead to substantial improvements in firm performance, which might result in competitive advantages for the outsourcing firms. A stronger market position might additionally boost demand for the product and services offered by those firms which at the end enables them to raise employment to satisfy this positive demand shift.

This paper is concerned with the outsourcing of information technologies (IT) and its effect on (medium-term) subsequent firm-level employment growth. IT outsourcing is a special case of outsourcing and it can be seen as the practice of turning over all or at least parts of an organisation's IT functions to an outside vendor.[1] Recent representative results from a survey among German manufacturing and service firms shows that more than 78 percent of firms with five and more employees are engaged in IT outsourcing. Thereby the shares in both sectors are almost equal. Especially firms in the service sector recently caught up, where the share of firms engaged in outsourcing increased by 15 percentage points compared to 2006 (ZEW, 2010).

Outsourcing has long been seen as a means to save costs, especially regarding IT outsourcing, where firms' poorly organised IT infrastructure led to a proliferation of costs. By outsourcing those services, firms expected to cut those costs significantly, and as a side effect, improving the quality of their IT services, too. However, the motivation to outsource has changed during the last couple of years. Nowadays, firms act more strategically by considering also additional aspects rather than purely short term cost advantages. At the centre of this discussion are the core competencies of the firm (Gottschalk and Solli-Saether, 2005). Firms should outsource their IT services to save resources and free management capacity, which in turn can be employed to concentrate on the strategic development of the firm. In the end, this can lead to a higher market share, and consequently, to more output. To satisfy the additional demand, an increase in employment is expected. Furthermore, IT outsourcing is a means to obtain access to the state-of-the-art technological advances in information technology. This helps to improve IT services and leads to more productive processes inside the firm (Ohnemus, 2007). Nevertheless, there are also risks associated with (IT) outsourcing, mainly regarding the relationship management (transaction costs) between the client and the vendor firm. An unprofessional relationship management can more than overcompensate the

[1] Basically, there are two distinctions to be made concerning an outsourcing relationship: the legal and the geographical dimension. While the first one differentiates between external providers (not legally related to the outsourcing company) and subsidiaries or affiliates, the second dimension refers to the geographical location of the service provider. Outsourcing to a provider abroad is usually referred to as offshoring. This paper is focussing on the 'real' external provision of IT services. Concerning the location of the vendor, there is no differentiation made between outsourcing and offshoring relationships, because the majority of firms in the data source out IT only locally. This can also be verified by other survey results (for Germany, see for example the ICT in enterprises survey 2007, conducted by the German Statistical Office).

advantages that are associated with IT outsourcing. The aim of this paper is therefore to investigate the impact of IT outsourcing on employment growth empirically.

The study is based on the ZEW ICT surveys conducted in 2004 and 2007 in the German manufacturing and selected service industries. A total of more than 1 100 observations is available for the empirical analysis. Firm growth refers to the period from 2003 to 2006 and is based upon the (firm-level) employment figures measured for both time periods. IT outsourcing describes if the firm outsourced at least one of the following three basic IT services to an external service provider: installation of hard- and software, computer system maintenance, user assistance and support. Due to the fact that IT outsourcing firms might be also the ones that are, overall, more successful, due to unobservable firm characteristics, like managerial abilities, this study controls for endogeneity by employing a two stage instrumental variable approach. Two instruments could be identified as particularly helpful: the drawing upon consulting for the year 2000 bug problem and the change in standard wages between 2000 and 2003.

As a main result, I find evidence that IT outsourcing has a positive effect on firms' employment growth rate. Dividing the sample into manufacturing and service firms, a medium-term positive growth effect of IT outsourcing, however, can only be observed in the service sector.

The paper is structured as follows: Section 2 illustrates the background discussion on IT outsourcing and the proximity of (IT) outsourcing and (process/organisational) innovation is developed. Further, empirical evidence is presented concerning innovation and outsourcing on the one hand and employment on the other hand. The analytical framework is laid out in Section 3. Section 4 depicts the data set. The empirical results are discussed in Section 5 and Section 6 concludes.

2 Background Discussion

Three strands of literature can be seen as relevant for the topic analysed. First, the literature on IT outsourcing which is extensive, but yet misses an analysis concerning the contribution of IT outsourcing to employment growth in contract granting firms. Secondly, the very extensive literature on employment growth at the firm level. Various determinants of growth have been analysed so far, with process innovation probably coming closest to the practice of outsourcing. Thirdly, there are some studies on the relationship between (general and not IT-specific) outsourcing and employment growth, which can give some insights for the research conducted in this paper.

So far, outsourcing still lacks a consistent definition, but basically, IT outsourcing involves the contracting out of information technology services, like the installation of hard- and software, computer system maintenance, user assistance and support, etc., to an external service provider. In the outsourcing context, legal and regional aspects are important characteristics of any outsourcing agreement. Legally, mostly *real* outsourcing, i.e. to a partner not legally associated with the client firm, is assumed. Regionally, we can differentiate between

outsourcing to providers in the home country and to those located abroad.[2] The regional aspect has gained importance during the last couple of years, when (IT) offshoring (e.g. to India, Philippines and Eastern Europe) became more and more available and attractive (at least for larger firms). One of the first definitions of IT outsourcing was given by Loh and Venkatraman (1992a, p. 9). They define IT outsourcing as *"the significant contribution by external vendors in the physical and/or human resources associated with the entire or specific components of the IT infrastructure in the user organisation."* This means that any hardware as well as human capital (for example specialised IT employees) can be outsourced both partly or completely. In their definition, Loh and Venkatraman do not differentiate between local and foreign IT outsourcing which is also not at the centre of interest in this paper, because of its minor importance for the German IT outsourcing market (see, for example, (Ohnemus, 2007)).

IT outsourcing experienced a boost after Eastman Kodak's landmark decision in July 1989 to hand over its entire data centre and microcomputer operations to an external consortium headed by IBM. This decision was widely seen as a major point of departure for the customary in-house mode of IT governance (Loh and Venkatraman, 1995). Due to the prominence of this case, IT outsourcing defused more rapidly as firms started to consider IT outsourcing as a viable strategic option (Loh and Venkatraman, 1992b). Information technology was no longer seen as absolutely strategic, and, therefore, not suitable for outsourcing. The mantra now was: *"If Kodak can do it, why can't every other organisation?"* (Dibbern et al., 2004, p. 8). In a fairly recent survey provided by Eurostat (2007), on average 44 percent of firms with at least 10 employees in the EU27 outsource (fully or partly) information and communication technology (ICT) functions which require ICT/IT specialists in 2006. Some Scandinavian countries even reach values of more than 70 percent. Germany is also well above the average, with 65 percent of firms involved in IT outsourcing.

Looking at the strategic intent behind the IT outsourcing decision of the firms, Lacity et al. (2009) give a comprehensive overview of research contributing to this topic (see also Table A.1 in the appendix). By far, *cost reduction* was the most common motive identified in the literature. But to focus on *core capabilities/competencies*, and *access to expertise and skills* immediately follows on second and third place. Although cost reduction is still a topic discussed in the IT outsourcing literature today, there is a shift observable in the perception of the motives for IT outsourcing. Strategic reasons gained increasing importance during the last years.[3,4]

---

[2] Note that outsourcing abroad is also known as offshoring.

[3] A representative survey among German firms (which is also the source of the data employed in the empirical part of this paper) constitutes that 69 percent of the IT outsourcing firms in 2004 see one of the main objectives for outsourcing in concentrating on core competencies. The higher quality services follows in the second place (53 percent) and cost reduction was mentioned only by 39 percent of the firms (ZEW, 2005).

[4] One of the most cited contributions to strategic IT outsourcing (in comparison to a pure cost saving outsourcing decision) has been made by DiRomualdo and Gurbaxani (1998).

Reasons for a positive impact of IT outsourcing on firm-level employment growth are for both considerations, cost or strategic outsourcing, conceivable. Reduced cost for IT services, achieved basically through economies of scale at the vendor side, leads to lower final product prices and, subsequently, to a higher demand for those products. To satisfy this higher demand, additional employees are necessary for producing these products. From a strategic point of view, IT outsourcing helps to conserve managerial effort, which then can be concentrated on the core capabilities of the firm, which have greater strategic potential for future success. Nevertheless, firms can still retain vitally important, and therefore core IT services, in-house (Smith et al., 1998), while outsourcing a significant portion of their non-core (and for their business success not so important) IT infrastructure/services. A second point here concerns the quality of IT services and firms' potential lack of knowledge to run their IT efficiently in-house. Service providers, due to their specialisation and their endowment with specialised IT personnel and top-end IT hardware, are able to offer IT services of higher quality and provide them more efficiently. Such improvements can be seen as process innovations which, in the end, might have a positive implication on employment.

In the literature, firm level employment growth is a well-treated topic, with numerous studies analysing employment growth from various perspectives. The comprehensive survey by Coad (2007) gives an overview of both empirical and theoretical aspects of this literature. Reviewing the previous literature more deeply, the relationship between innovation and employment seems to fit the undertaken analysis in this paper best. According to the Oslo manual, *organisational innovations* also include outsourcing of activities to external partners. In detail, an organisational innovation is defined as *"the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations"* (OECD, 2005). Organisational innovations are intended to increase firm performance by reducing costs, improving labour productivity and gaining access to external knowledge. The distinction, however, between *process*[5] and *organisational* innovations is frequently difficult, since both types of innovations seem to be similar, particularly regarding the mechanism of how they affect firm performance.

Comparing assumed firm level effects of organisational/process innovations and outsourcing, similarities can also be found. Process innovations tend to displace labour (for a given output), since they are likely to reduce the quantities of most factors (including labour) required (Harrison et al., 2008). This, although much simpler, is also the case with IT outsourcing. Since IT specialists, formerly providing those IT services in-house, are displaced by the employees of the service provider, the immediate employment effect of outsourcing is assumed to be negative. In a second step, unit costs are reduced, due to labour (and/or capital) productivity increases associated with process innovations. Demand is stimulated through reduced product prices and, as a consequence, output and employment are rising (Harrison et al., 2008). For IT outsourcing, empirical evidence of productivity effects, especially with

[5] A process innovation is defined as "the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD, 2005).

respect to employees working at a computerised workplace, are found by Ohnemus (2007). Through higher productivity and, additionally, through lower costs for the outsourced services, the unit costs of production are decreased. Depending on the competitive conditions of the firm, this cost reduction is likely to result in lower prices, which will stimulate demand, and hence output and employment.

Previous empirical literature on the employment effects of process/organisational innovations finds varying results. Looking at the R&D intensity of the firm (as an indicator for innovation), Hall (1985) observes that employment growth is related positively and significantly to R&D intensity. Additionally to R&D intensity, Greenhalgh et al. (2001) observe also that the number of patent publications have a positive effect on employment growth. Brouwer et al. (1993) present positive empirical evidence relating to product innovation activities and employment growth (although the effect is economically small). However, R&D cooperation, as a form of process and/or organisational innovation, turns out to have no influence on employment growth. Further, concerning process innovations, Doms et al. (1998) observe that the use of advanced manufacturing technology (which is assumed to correspond to process innovation) has a positive effect on employment. Van Reenen (1997) reveals a positive effect on employment for product innovations but insignificant results for process innovations. For manufacturing industries, Smolny (1998) shows that process innovations increase output and employment. However, the transmission mechanism remains unclear, since there is no price decreasing effect of process innovations observable. In their comparable analysis of four European countries (France, Italy, the UK and Germany), Harrison et al. (2008) observe a positive effect of product innovations on employment growth, whereas process innovations appear to have a negative effect on employment. Since the empirical evidence from this strand of literature gives no clear hint about the direction of the overall effect on employment, it is difficult to derive a hypothesis about IT outsourcing and employment growth. After all, it remains an empirical question to identify the direction of the analysed relationship.

Various other determinants of employment growth have been considered in the literature, the most prominent among them are firm size and age (Dunne and Hughes, 1994; Evans, 1987a; Variyam and Kraybill, 1992),[6] financial performance, productivity, ownership structure (Harhoff et al., 1998), unionisation (Leonard, 1992) and the existence of a work council (Jirjahn, 2009), to mention a few. The available data set allows to control for a number of those variables (see Section 3).

To the best of my knowledge there is no research yet available analysing the relationship between IT outsourcing and employment growth at the firm level. However, some contributions are made relying on the broader defined service outsourcing and offshoring. Since service outsourcing generally covers a wide variety of different functions, including also non-knowledge-intensive services like caretaker activities or security services, the results achieved in those studies can only give a first hint on what one might expect when it comes

[6] The age and the size of the firm are of course interrelated. Sometimes both are taken to represent what is essentially the same phenomenon (Coad, 2007).

to outsourcing of knowledge intensive IT services. Hijzen et al. (2007) are among the first to provide firm-level evidence for the impact of service offshoring on employment. They find no evidence that the imports of intermediate services are associated with job losses. Actually, firms that import services have faster employment growth than those that do not. This might be a result of the cost-saving or productivity effects of offshoring, which give rise to an increase in the scale of production. Chongvilaivan et al. (2008) reveal a positive impact of service outsourcing on relative wages and the demand for skilled workers. This can be explained by the idea that outsourcing allows firms to specialise in upstream production activities where usually a greater number of skilled workers is employed. Recent work by Moser et al. (2009), using German establishment data, finds that offshoring establishments have higher productivity, higher market share and higher employment —compared to their non-offshoring counterparts. Although they are not differentiating between material and service offshoring,[7] which would be better comparable to IT outsourcing, this result suggests a positive effect of (international) outsourcing on employment at the firm level.

3 Analytical Framework

The analytical framework considers, besides the impact of IT outsourcing on employment growth, various other control variables which were found to be important in the previous firm-level employment growth literature. The model to be estimated can be specified as:

$$g_i = \alpha + \beta\, ITout_i + \boldsymbol{X_i}\boldsymbol{\gamma} + \epsilon_i, \tag{1}$$

where g_i is the annual growth rate of firm i's workforce as defined later in equation (2) and $ITout_i$ is the dummy variable indicating if firm i sources out basic IT services. The vector $\boldsymbol{X_i}$ contains all the other explanatory variables included in the employment growth regression (e.g. original firm size, qualification structure of the employees, firm age, future business prospects, workplace practices, exposure to competition, etc.).

Equation (1) can be estimated by ordinary least square (OLS). However, it might be expected that IT outsourcing is not truly exogenous and therefore, it is impossible to make causal claims based upon OLS estimates. There are various unobserved firm characteristics which make the observed relationship between outsourcing and employment growth endogenous. So, for example, firms with a better management operate more successfully in the market. Their output increases compared to one of their competitors. As a consequence, those firms also show a higher employment growth rate. At the same time, better managed firms are more prone to IT outsourcing, since the executives of those firms recognise the strategic advantage of IT outsourcing. In the case of endogeneity, OLS estimates would be biased and inconsistent. To account for this endogeneity problem, I apply a two stage least squares instrumental variable approach.

[7] Offshoring is defined as the share of foreign to total inputs.

For implementing instrumental variable regressions, suitable instruments must be at the hand of the researcher. I decided to choose two instruments, a dummy variable indicating if firm i was involved in *Y2K consulting* (see also Ohnemus, 2007) and the change in standard wages between 2000 and 2003. The *Y2K consulting* variable refers to the *Year 2000 problem* (also known as the *Y2K bug*, or the *millennium bug*). This was a computer-related problem which resulted from the practice of abbreviating a four-digit year to the last two digits. In computer programs, the practice of representing the year with *two* digits becomes problematic with logical error(s) arising upon "rollover" from x99 to x00. This has caused some date-related processing to operate incorrectly for dates and times on and after January 1, 2000. Without corrective action, it was suggested that long-working systems would break down when the "... 97, 98, 99, 00 ..." ascending numbering assumption suddenly became invalid.[8] As the awareness of this problem arose, companies and organisations around the world checked, fixed, and upgraded their computer systems. On the one hand, the incidence of the Y2K bug is exogenous to all firms (having computers implemented in their businesses). On the other hand, it is plausible to assume that firms, once relying on external support for a computer related problem, are more prone to outsource later on their computer services externally. As a second instrument, I choose the increase in standard wages between 2000 and 2003 as provided by the German Statistical Office.[9] Since increases of the pay roll are in favour of the outsourcing decision (since external provision is nevertheless assumed to be cheaper, because of scale effects), I assume that wage bill increases, previous to the growth rate calculation period, have no impact on employment growth between 2003 and 2006.

Further establishment characteristics are important to explain employment growth. One of the most outstanding variables, and therefore at the centre of numerous studies, is firm size, measured by the number of employees. In this context, Gibrat's law of proportional growth, which states that the probability of a proportionate increase in firm size over an interval in time is the same for all firms, regardless of their size at the beginning of the interval. In short, the original size of the firm and its growth rate are independent. However, empirically, this *law* is not universally confirmed. A large and growing body of research is rather finding evidence of a (slightly) negative relationship between growth rates and firm size, so, for example, Kumar (1985) and Dunne and Hughes (1994) for the United Kingdom, Hall (1985) and Evans (1987a,b) for U.S. firms, Almus and Nerlinger (2002) for Germany and Goddard et al. (2000) for Japan. Some researchers maintain that Gibrat's law holds only for firms above a certain size threshold. Hart and Oulton (1996) find for a large sample of UK firms that mean reversion, i.e. small firms grow faster than large firms, is observed in the overall sample, while a decomposition of the data according to size classes reveals no relationship between size and growth for large firms (see also Geroski and Gugler, 2004, for

[8] This paragraph draws mainly on the Wikipedia entry for the Y2K-problem, see `http://en.wikipedia.org/wiki/Year_2000_problem` (February 24, 2010).

[9] This two digit industry level date is published in *Fachserie 16, Reihe 4.3* of the German Statistical Office. For the two-digit industries, where no data was available, the average evaluation of standard wages in Germany between 2000 and 2003 was imputed.

a similar result). Because several authors (Dunne and Hughes, 1994; Evans, 1987a; Harhoff et al., 1998) find a highly nonlinear inverse size-growth relationship, I account for this by including a second order polynomial in the logarithm of firm size measured by the number of employees in the estimation model.

Qualification plays a crucial role in the development and the success of a firm. The qualification of the workforce is captured by the share of employees with a university degree (*share university*) and the share of employees with vocational education (*share vocational*). Technology, especially information and communication technology affinity is captured by the share of employees working at a computerised workplace (*share computer employees*). The employment effects from the use of new technologies can be twofold, from a theoretical point of view. If the technology is labour saving, a firm can produce the same output with fewer employees. The cost-reducing aspect of the new technology, on the other hand, results in a competitive advantage which can lead to a higher market share of the firms products and will increase subsequently output and employment. Blanchflower and Burgess (1998) show that the positive employment effect dominates.

Firm's exposure to competition is captured by the inclusion of three measures. The first variable states whether a firm is active on the export market. The second measure indicates whether the company belongs to a group of firms. Finally, the third variable is an indicator of whether a firm has a foreign subsidiary. All three variables are binary indicators, taking the value one if the mentioned aspect applies for a firm. The existence of a work council might play a significant role for employment growth. Indeed, Jirjahn (2009) finds a positive growth effect of works council for German manufacturing firms. Therefore, a dummy variable for the existence of a work council is included into the model. Since the typical dual system of employee representation in Germany (unions and work councils) especially applies to the manufacturing sector (Addison et al., 2007), a positive effect of the existence of a work council is expected for manufacturing firms. Some authors emphasise the importance of the age of a firm for subsequent employment growth. For example, Dunne and Hughes (1994) find a negative relationship between firm age and employment growth. I account for firm age by including two dummies, one for relatively young firms being of age 0-3 years in 2003 and one for middle aged firms, being of age 4 to 7 years in 2003. The reference category are all firms older than 7 years.

A last important group of control variables deals with the organisation of work within the firm. Innovative workplace practices, especially when the whole system of work organisation is changed, results in enhanced productivity (Ichniowski et al., 1996). Improved productivity in turn strengthens the competitive position of the firm and therefore might result in a positive effect on employment growth. Three measures for new organisational practices are available: *quality circle*, *self dependent teams*, and *units with own cost and profit responsibility*. Each aspect is accounted for by the inclusion of a dummy which takes the value of one if the respective organisational structure exists in a firm.

Employment growth is certainly dependent upon the business situation and the business prospect of a firm. Therefore, I include a variable indicating the expected growth in turnover

on a three point likert scale (reduction, unchanged and increasing) for the year 2004 compared to 2003. Additionally, a dummy for East Germany is included to account for regional (and institutional) differences between East and West German firms. Finally, 13 industry dummies are included in the overall regression model to control for industry specific effects.

Remember that the choice of the time span for which the firm growth rate is calculated (three years) is aimed at looking at the medium-term impact of IT outsourcing on firm-level employment. This makes sense, since for any shorter time span, a negative effect would almost certainly be expected. In the short run, the displacement of jobs directly resulting from outsourcing (herby effected are basically specialised IT employees) might dominate the positive effects of outsourcing leading to more employment.

4 Data

The data used for the empirical analysis stems from the ZEW ICT survey, a computer assisted telephone survey conducted in German manufacturing and service firms. The data was collected in 2004 and 2007. In each year, around 4 400 firms were surveyed. Stratification was made by industry affiliation (14 sectors),[10] firm size (eight size classes according to the number of employees) and region (West or East Germany).[11] The ZEW ICT survey is particularly focusing on the diffusion and the use of information and communication technologies. Furthermore, there are a number of variables controlling for numerous firm characteristics. Since the ZEW ICT survey is constructed as a panel, I merge the 2004 and 2007 waves in order to calculate the employment growth rate. After combining the two survey waves and considering item-non response, 1 154 observations remain for the empirical analysis.[12]

In the ZEW ICT survey, employment is measured as the average yearly number of employees of the firm. For the survey conducted in 2004, the average employment for 2003 is available and for the 2007 survey, employment figures refer to 2006. The employment growth rate is defined as the annual rate of employment change over the three year period from 2003 to 2006. Denoting the employment level of firm i in 2003 by L_i^{2003} and the level in 2006 by L_i^{2006}, the growth rate of firm i is defined as:[13]

$$g_i = \left[\frac{\ln(L_i^{2006}) - \ln(L_i^{2003})}{3} \right]. \tag{2}$$

[10] For a detailed list of the included sectors, see Table A.6.

[11] The underlying survey sample is drawn from the data base of the *Verband der Vereine Creditreform*, Germany's largest credit rating agency.

[12] Some of the observations have to be dropped due to implausible growth rates, either caused by a wrong entry concerning the number of employees by the interviewer or by different reference companies in the two survey waves.

[13] Alternatively, two differently defined growth rates are employed for robustness checks: the compound annual growth rate, defined as: $\tilde{g}_i = (L_i^{2006}/L_i^{2003})^{\frac{1}{3}} - 1$, and a growth rate used by Davis and Haltiwanger (1992) upon others which is defined as: $\tilde{\tilde{g}}_i = \left[(L_i^{2006} - L_i^{2003})/3\right] / \left[(L_i^{2006} + L_i^{2003})/2\right]$. The last one may reduce the impact of outliers, since changes in employment are divided by average employment.

As Table 2 shows, employment grew in the observed period between 2003 and 2006 on average by 0.39 percent per annum. The mean growth rate in the manufacturing sector is higher and lower in the service sector compared to the overall value.

Table 1: Share of observations by industry and IT outsourcing intensity

			thereof IT outsourcing	
Industry	**in % of obs.**	**# of obs.**	**in %**	**# of obs.**
Manufacturing:				
consumer goods	9.10	105	41.90	44
chemical industry	5.46	63	44.44	28
other raw materials	7.54	87	44.83	39
metal and machine construction	11.01	127	36.22	46
electrical engineering	6.41	74	20.27	15
precision instruments	10.14	117	36.75	43
automobile	5.72	66	40.91	27
Services:				
wholesale trade	5.46	63	49.21	31
retail trade	8.06	93	48.39	45
transport and postal services	7.37	85	43.53	37
banks and insurances	6.93	80	36.25	29
technical services	8.93	103	27.18	28
other business-related services	7.89	91	46.15	42
Total	100.00	1 154	39.34	454

Source: ZEW ICT survey 2004 and own calculations.

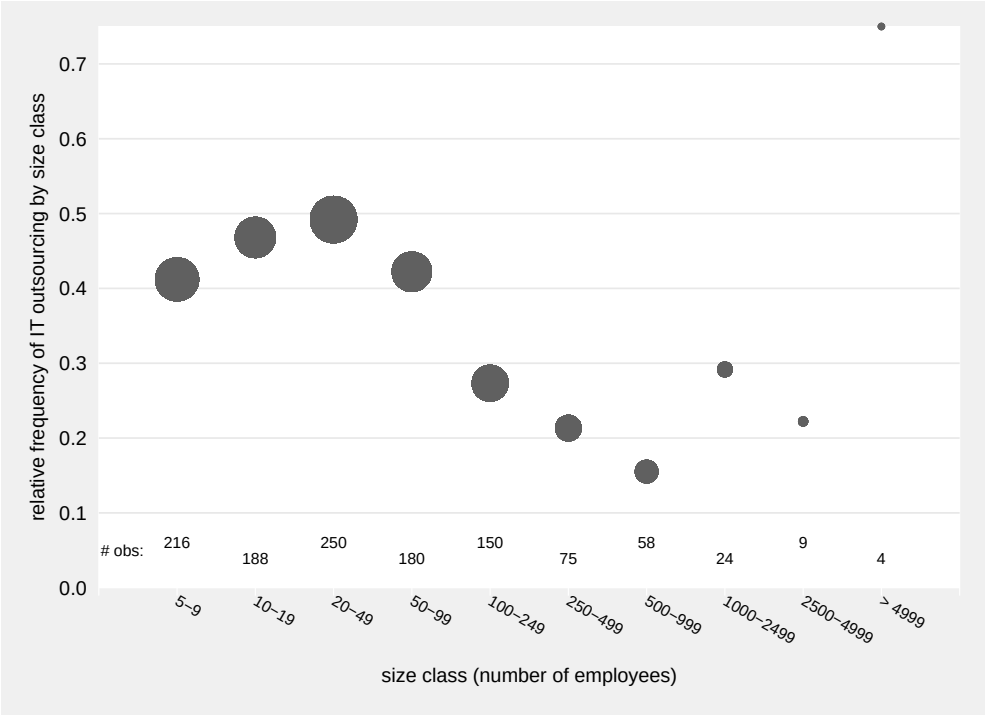
The 2004 wave of the ZEW ICT survey contains information about a broad range of IT services companies potentially need for running their business. Firms were asked if they have outsourced each of those activities partially or fully to an external service provider. The activities covered range from basic IT services, like *hard- and software installation*, *computer system maintenance* and *user assistance and support*, to more sophisticated services, such as *software programming* and *IT security*. The empirical analysis is restricted to the outsourcing of basic IT services which includes the first three items mentioned above. The reason for that is that those services are required in every firm using computer technology in their business operations. More sophisticated IT services might not be needed by firms at all. Therefore, one would have a two-stage decision process. Firstly, the question whether a firm needs a specific service and secondly, the firm's make or buy decision. To avoid this problem, I focus on basic IT services only. IT outsourcing is defined by a binary variable which takes the value one if firm i outsources at least one of the three above mentioned IT services completely to an external service provider and zero otherwise.[14] Due to the fact that outsourcing is mainly

[14] There is a strong correlation between the dummy variables (indicating complete outsourcing) of the three basic IT services, which suggests that a basic IT outsourcing indicator can be reliably constructed out of those three IT service variables.

realised at home, using German service providers as outsourcing partners, I exclude the *electronic processing and telecommunication* industry from the estimation sample, since this industry mainly comprises those firms providing IT outsourcing.

An overview of the sample structure by industry affiliation and the IT outsourcing intensity is given in Table 1. More than 55 percent of the firms in the sample belong to the manufacturing industries. Therein, *metal and machine construction* and *precision instruments* are the largest sub-industries. In the service sector, all sub-industries (besides *wholesale trade*) are almost equally distributed in the sample.

Figure 1: IT outsourcing and firm size



Note: Size classes (in number of employees) versus the relative frequencies of IT outsourcing. The size of the dots indicates the number of firms in the considered interval.
Source: ZEW ICT survey 2004 and own calculations.

About 39 percent of the firms are involved in basic IT outsourcing. The *other raw materials industry* in the manufacturing sector is thereby most active with 45 percent of firms involved in IT outsourcing. On the other hand, the *electrical engineering* industry reaches only a value of 20 percent. In the service sector, the average outsourcing intensity is about 3 percentage points higher than in the manufacturing sector. Here, firms from the *wholesale trade* and *retail trade* are the most active outsourcers. Interestingly, the technologically advanced *technical services* industry is least active with an outsourcing share of only 27 percent. Figure 1 shows the relative frequencies of IT outsourcing in relation to firm size measured in number of employees. Since the outsourcing variable is binary, the relative frequencies are obtained by grouping the number of employees in size classes. The size of the individual dots reflects the number of firms in each group. After a slight increase in the outsourcing intensity in the three smallest size classes, the frequency drops sharply and

continues to fall for the group of firms between 50 and 999 employees. For the larger firms with more than 999 employees, an increasing outsourcing tendency is observable, although this is based on a relatively small number of observations as indicated by the size of the dots.

All other establishment characteristics which are used to explain employment growth between 2003 and 2006 are listed in Table 2. All those variables refer to the year 2003 (and sometimes 2004). The average firm in the sample employs 182 employees in 2003. There are relatively more small firms with less than 50 employees in the service sector than in manufacturing. Overall, the mean value of the university share is 19 percent and the vocational share is almost 60 percent. While the university share is substantially lower in the manufacturing sector, the vocational share is almost identical in the manufacturing and the service sector. The average share of computer users is 44 percent and substantially higher in the service sector. In approximately 34 percent of all firms in the sample, a work council is installed. They are more prevalent in manufacturing industries, with 42 percent of firms having this kind of employee's representation, than in the service sector (24 percent).[15] In the sample, the vast majority of firms (81 percent) is older than 7 years. This result is relatively stable in both sectors.

5 Empirical Results

Based on equation (1), three different specifications are estimated. While the first specification excludes variables describing the qualification structure of the employees and the information about the share of employees working predominantly at a computerised workplace, the following two specification include those variables successively. Estimation results are presented in Table 3. The first column for each specification shows the first stage results, the second column then presents the final estimates.

As we can see in the first line of Table 3, in all three specifications the coefficient of IT outsourcing is positive and significantly different from zero, implying a positive effect on the employment growth rate. Also, the magnitude of the coefficients for IT outsourcing is quite stable over all three specifications. While in the first case (without the qualification and computerisation employment share variables included), the mean effect in changing from non-IT outsourcing to IT outsourcing results in a 6.4 percent higher employment growth rate, the effect is only slightly smaller in the specification with qualification and computerisation variables included. This result supports the hypothesis that IT outsourcing improves firm performance (and maybe lowers producer prices), which results in the medium-term firm-level employment growth.

Turning to the interpretation of the control variables, the negative and significant coefficient of log labour is noticeable. The negative effect, although decreasing (as indicated by the positive sign of the squared log labour variable), rejects the validity of Gibrat's law of

[15] The difference in the diffusion of work councils might partly result from the differences in firm size in both groups. Since the firms in the manufacturing subsample are larger, the probability for the existence of a work council is higher in this sector.

Table 2: Descriptive statistics

	All firms		IT outsourcing		non-IT outsourcing		Dummy
	Mean	**STD**	**Mean**	**STD**	**Mean**	**STD**	**variable**
employment growth rate	0.0040	0.1150	0.0083	0.1213	0.0013	0.1106	no
employees (2003)	181.6568	622.2314	158.1278	783.0564	196.9171	490.5772	no
size: 5-9 employees	0.1872	0.3902	0.1960	0.3974	0.1814	0.3856	yes
size: 10-19 employees	0.1629	0.3694	0.1938	0.3957	0.1429	0.3502	yes
size: 20-49 employees	0.2166	0.4121	0.2709	0.4449	0.1814	0.3856	yes
size: 50-249 employees	0.2860	0.4521	0.2577	0.4379	0.3043	0.4604	yes
size: $>$ 249 employees	0.1473	0.3546	0.0815	0.2739	0.1900	0.3926	yes
IT outsourcing	0.3934	0.4887	–	–	–	–	yes
Y2K consulting	0.5260	0.4995	0.6564	0.4754	0.4414	0.4969	yes
index standard wages	9.9610	1.0085	9.9370	0.9682	9.9766	1.0342	no
share university	0.1900	0.2366	0.1540	0.2075	0.2134	0.2511	no
share vocational	0.5989	0.2627	0.6326	0.2516	0.5770	0.2676	no
share computer employees	0.4360	0.3268	0.3977	0.3188	0.4608	0.3298	no
quality circle	0.4021	0.4905	0.3678	0.4827	0.4243	0.4946	yes
units w/ cost/profit resp.	0.3094	0.4624	0.2731	0.4461	0.3329	0.4716	yes
self dependent team	0.5763	0.4944	0.5507	0.4980	0.5929	0.4917	yes
exporter	0.4896	0.5001	0.4295	0.4956	0.5286	0.4995	yes
group of firms	0.3284	0.4698	0.2996	0.4586	0.3471	0.4764	yes
foreign subsidiary	0.0858	0.2802	0.0507	0.2195	0.1086	0.3113	yes
work council	0.3362	0.4726	0.2533	0.4354	0.3900	0.4881	yes
age: 0-3 years	0.0451	0.2075	0.0308	0.1731	0.0543	0.2267	yes
age: 4-7 years	0.1490	0.3563	0.1520	0.3594	0.1471	0.3545	yes
age: $>$ 7 years	0.8059	0.3957	0.8172	0.3869	0.7986	0.4014	yes
expected turnover	1.1880	0.7498	1.1916	0.7344	1.1857	0.7601	no
East Germany	0.2435	0.4294	0.2709	0.4449	0.2257	0.4184	yes
consumer goods	0.0910	0.2877	0.0969	0.2962	0.0871	0.2822	yes
chemical industry	0.0546	0.2273	0.0617	0.2408	0.0500	0.2181	yes
other raw materials	0.0754	0.2641	0.0859	0.2805	0.0686	0.2529	yes
metal and machine const.	0.1101	0.3131	0.1013	0.3021	0.1157	0.3201	yes
electrical engineering	0.0641	0.2451	0.0330	0.1789	0.0843	0.2780	yes
precision instruments	0.1014	0.3020	0.0947	0.2931	0.1057	0.3077	yes
automobile	0.0572	0.2323	0.0595	0.2368	0.0557	0.2295	yes
wholesale trade	0.0546	0.2273	0.0683	0.2525	0.0457	0.2090	yes
retail trade	0.0806	0.2723	0.0991	0.2992	0.0686	0.2529	yes
transport and postal serv.	0.0737	0.2613	0.0815	0.2739	0.0686	0.2529	yes
banks and insurances	0.0693	0.2541	0.0639	0.2448	0.0729	0.2601	yes
technical services	0.0893	0.2852	0.0617	0.2408	0.1071	0.3095	yes
other business-related serv.	0.0789	0.2696	0.0925	0.2901	0.0700	0.2553	yes
# of observations	1 154		454		700		

Note: All variables (if not indicated otherwise) refer to the years 2003 or 2004.
Source: ZEW ICT survey 2004, 2007 and own calculations.

Table 3: IV estimation results for all firms

	Spec. 1		Spec. 2		Spec. 3	
	first	**second**	**first**	**second**	**first**	**second**
IT outsourcing		0.0640**		0.0625**		0.0622**
		(0.0297)		(0.0295)		(0.0294)
Y2K consulting	0.2298***		0.2303***		0.2308***	
	(0.0289)		(0.0288)		(0.0288)	
index standard wages	0.0678***		0.0657**		0.0660**	
	(0.0260)		(0.0260)		(0.0260)	
log labour	-0.0005	-0.0450***	-0.0082	-0.0427***	-0.0115	-0.0422***
	(0.0433)	(0.0101)	(0.0426)	(0.0101)	(0.0430)	(0.0101)
log labour squared	-0.0053	0.0044***	-0.0047	0.0042***	-0.0045	0.0042***
	(0.0052)	(0.0010)	(0.0051)	(0.0010)	(0.0052)	(0.0010)
share university			-0.2131**	0.0301	-0.1465	0.0201
			(0.0858)	(0.0239)	(0.0925)	(0.0256)
share vocational			0.0134	0.0282	0.0322	0.0254
			(0.0696)	(0.0194)	(0.0702)	(0.0194)
share computer employees					-0.1033*	0.0153
					(0.0563)	(0.0141)
quality circle	0.0153	0.0143**	0.0147	0.0141**	0.0150	0.0141**
	(0.0309)	(0.0071)	(0.0307)	(0.0071)	(0.0307)	(0.0071)
units w/ cost/profit resp.	-0.0079	0.0146*	-0.0021	0.0132	0.0011	0.0128
	(0.0339)	(0.0085)	(0.0341)	(0.0085)	(0.0340)	(0.0085)
self dependent team	-0.0244	-0.0114	-0.0228	-0.0115	-0.0171	-0.0124*
	(0.0294)	(0.0071)	(0.0293)	(0.0071)	(0.0294)	(0.0072)
exporter	-0.0559	0.0173*	-0.0430	0.0170*	-0.0365	0.0160*
	(0.0353)	(0.0091)	(0.0354)	(0.0089)	(0.0355)	(0.0089)
group of firms	0.0116	0.0072	0.0074	0.0066	0.0084	0.0065
	(0.0357)	(0.0100)	(0.0358)	(0.0101)	(0.0358)	(0.0101)
foreign subsidiary	-0.0452	-0.0122	-0.0264	-0.0124	-0.0275	-0.0122
	(0.0587)	(0.0148)	(0.0590)	(0.0144)	(0.0587)	(0.0143)
work council	-0.0739*	0.0050	-0.0722*	0.0041	-0.0706*	0.0038
	(0.0408)	(0.0079)	(0.0408)	(0.0078)	(0.0406)	(0.0077)
age: 0-3 years	-0.1280**	0.0114	-0.1368**	0.0106	-0.1376**	0.0107
	(0.0645)	(0.0152)	(0.0641)	(0.0153)	(0.0652)	(0.0153)
age: 4-7 years	0.0236	-0.0068	0.0256	-0.0068	0.0274	-0.0070
	(0.0396)	(0.0125)	(0.0395)	(0.0125)	(0.0394)	(0.0125)
expected turnover	0.0230	0.0176***	0.0254	0.0178***	0.0273	0.0176***
	(0.0186)	(0.0050)	(0.0187)	(0.0049)	(0.0187)	(0.0049)
East Germany	0.0372	0.0042	0.0486	0.0015	0.0415	0.0025
	(0.0337)	(0.0084)	(0.0343)	(0.0084)	(0.0344)	(0.0084)
constant	-0.3154	0.0545**	-0.2711	0.0286	-0.2629	0.0271
	(0.2869)	(0.0259)	(0.2940)	(0.0324)	(0.2930)	(0.0327)
industry dummies	yes	yes	yes	yes	yes	yes
R^2	0.1176		0.1251		0.1277	
Sargan-test		0.1924		0.1799		0.1792
# of observations	1 154	1 154	1 154	1 154	1 154	1 154

Note: Dependent variable: employment growth rate (2003-2006). *,** and *** indicate significance at the 10%, 5% and 1% level respectively. Robust standard errors are reported in parentheses. 13 industry dummies are included in the regressions. For the Sargan-test, p-values are reported.
Source: ZEW ICT survey 2004, 2007 and own calculations.

proportional growth in this data set. It rather states that small firms show a higher employment growth rate than large firms. Including labour force quality measures (share of employees with vocational training or university degree, respectively) does not change the main result significantly, as mentioned already. Furthermore, those variables do not exercise any significant effect on the employment growth rate. The same holds true for the share of employees working at a computerised workplace, which is also an indicator for the IT intensity of the firm. Workplace practices, like the existence of a quality circle and units with cost and profit responsibility have the expected positive effect on employment growth, though, the coefficient for units with cost/profit responsibility is not significant in the second and third specification. Self dependent teams have a weakly significant negative effect on employment growth in the extensive third specification. This is somehow contrary to the expected result, since the existence of self dependent teams, which implies decentralised management practices, was also expected to have a positive impact on employment. The fact that a firm exports its products or services leads to an increased employment growth rate. This is interesting since also a negative effect could be expected because of higher competitive pressure which results in higher productivity (and less employment). But the additional demand from abroad seems to overcompensate this negative effect. Opposed to earlier research findings, the age of the firm has no significant impact on growth in this analysis. However, the age effect might already be captured by the employment size measure (log labour). The last coefficient which turns out to have a significant and positive sign is firms' perception about future growth in turnover.

It might be assumed that the outsourcing of services has different effects in manufacturing and service industries, since the service sector relies more heavily on service inputs compared to the manufacturing sector. Therefore, I split up the available sample into manufacturing and service firms and ran additional regressions to the ones presented in Table 3. Results are shown in Tables A.4 and A.5 (in the appendix). The interpretation of the results is straightforward and I will fist concentrate on the results for the manufacturing firms, as presented in Table A.4.

Most strikingly, the coefficient for IT outsourcing turns out to be insignificant now, although the effect is still positive in all three specifications. Compared to the magnitude of the result for all firms, the IT outsourcing coefficient shows only half the size for the firms in the manufacturing industries. Since general IT applications in manufacturing do not play such a dominant role, positive business effects from outsourcing might be comparably small. On the other side, specialised IT applications in the production process, which might have a greater effect on business performance, are not outsourced, since they belong to the core competency of the firms. Concerning the rest of the estimates, Gibrat's law is again rejected by the negative and significant coefficient of the size parameter measured in log employees. Interestingly, the qualification of the employees and all three workplace practices included do not affect employment growth significantly. The only coefficient which shows an increase in size (and also in the level of significance) is the exporting indicator. This is unsurprising though, since especially German manufacturing firms rely heavily on the demand from

abroad. An expected increase in future turnover is also positive and significant and the effect is slightly larger than in the overall sample.

The estimation result for the service firms are presented in Table A.5. IT outsourcing has a positive and significant impact on employment growth in the service sector. Employment growth is in the range of 10.5 percent higher for IT outsourcing firms compared to their non-outsourcing counterparts. Again, Gibrat's law is rejected by the negative and significant log labour coefficients. Work organisation in the service sector seems to play an influential role for employment growth, although in different directions, as shown by the positive and significant coefficient for quality circles and the negative and significant coefficients for self dependent teams. Regarding the insignificant impact of those workplace organisation variables in the manufacturing subsample, the overall result seems to be driven by the service sector effects. The exporting indicator, however, is not significantly different from zero anymore. The same is true for expected future turnover.

The issue of model validation for discussion remains, especially the validity of the chosen instruments. In all specifications, the Sargan-test is rejected and hence, there is no indication of overidentification in any of the specifications. Altogether, the outsourcing of basic IT services to external providers has a significant impact on subsequent medium-term firm-level employment growth. However, when splitting up the sample into manufacturing and service firms, this effect is only significant in the service sector.

Table 4: IV estimation for different employment growth rate calculations

	All firms	**Manufacturing**	**Service**
Dep. Var.: g_i			
IT outsourcing	0.0622**	0.0342	0.1046**
	(0.0294)	(0.0312)	(0.0515)
Sargan-test	0.1792	0.1457	0.1954
Dep. Var.: $\tilde{g}_i$			
IT outsourcing	0.0508*	0.0310	0.0825*
	(0.0261)	(0.0300)	(0.0440)
Sargan-test	0.1587	0.1494	0.1607
Dep. Var.: $\tilde{\tilde{g}}_i$			
IT outsourcing	0.0599**	0.0348	0.0978*
	(0.0300)	(0.0325)	(0.0517)
Sargan-test	0.1850	0.1260	0.2331
# of observations	1 154	639	515

Note: *,** and *** indicate significance at the 10%, 5% and 1% level respectively. Robust standard errors are reported in parentheses. Estimations were carried out according to specification 3 in Tables 3, A.4 and A.5, respectively. The alternative growth rates are calculated as $\tilde{g}_i = (L_i^{2006}/L_i^{2003})^{1/3} - 1$ and $\tilde{\tilde{g}}_i = \left[(L_i^{2006} - L_i^{2003})/3\right] / \left[(L_i^{2006} + L_i^{2003})/2\right]$, where L_i^t refers to the number of employees of firm i at time t. For the Sargan-test, p-values are reported.
Source: ZEW ICT survey 2004, 2007 and own calculations.

To check the robustness of the results, I re-estimate the previous results by applying different methods for employment growth rate calculation.[16] Results of the IT outsourcing coefficient for different dependent variables (different growth rate calculations) and different samples (all firms, manufacturing firms and service firms) are shown in Table 4. The top part of the table lists the results already presented in Tables 3, A.4 and A.5 for reasons of comparability. The rest of the table then presents the estimated coefficients for IT outsourcing for the alternative growth rate calculations. As can easily be observed, the size and the significance of the estimates only changes slightly compared to the original regressions. For the manufacturing sector, the effect on employment growth still remains positive but insignificant in both additional estimations. In the overall estimation and the one for the service firms only, the impact of IT outsourcing on employment growth seems to be somewhat smaller.

6 Concluding Remarks

The aim of this paper is to analyse the effects of IT outsourcing on firm-level employment growth in the medium-term. Using an instrumental variable approach accounts for the possible endogeneity of IT outsourcing and the employment growth rate. German firm-level data from a comprehensive survey conducted in the years 2004 and 2007 is utilised.

Summarising the results, I find that IT outsourcing indeed influences the firm-level growth rate positively. Over all firms, the engagement in IT outsourcing raises the growth rate by more than 6 percent. By splitting the sample in manufacturing and service firms, further analyses reveal, however, that only the growth rate of firms in the service sector sector is significantly and positively affected by IT outsourcing. Indeed, manufacturing firms show also a positive coefficient, but this is not significant at any conventional significance level. The reason for the difference in both subsamples might be found in differing need and extent of usage of information technology in both sectors. While IT is widely used in the service sector, it is less diffused in manufacturing. This can be verified by the share of employees working at a computerised workplace, which is on average 24 percentage points higher in the service sector. The minor importance of IT in manufacturing will also reduce the positive effects of IT outsourcing for the firms, and, as a consequence, its impact on employment growth.

There are some limitations underlying this research. First, firm exit is not observed in the available data. However, research in the past showed that firm exit plays a minor role, especially when short to medium time span growth rates are analysed (Hall, 1985). Additionally, firm exit is relevant, especially when very small firms are in the data, since their probability of leaving the market is considerably higher. The ZEW ICT survey is observing only firms with five and more employees and therefore skips those firms. Hence, I assume that firm exit did not influence the results significantly. Secondly, the observed time

[16] See footnote 13 for alternative growth rate calculation methods.

span of the growth rate is, as repeatedly mentioned, only three years. While a shorter time span would almost certainly lead to a negative impact of IT outsourcing because specialised IT employees are displaced (or transferred to the outsourcing service provider)[17] and this reduction is hardly to be compensated by the positive effects of outsourcing, the long run impact is not clear yet. If firms tend to outsource IT services to achieve short to medium run advantages, the negative effects of outsourcing, namely loosing too much control and scope over the own processes, can, in the long run, affect outsourcing firms' employment growth rate negatively. Unfortunately, data to test this empirically is not available yet. And last, the scope of this research was to analyse IT outsourcing. A differentiation between outsourcing and offshoring could not be made because of data restrictions. This aspect has therefore to be left for future research.

[17] Indeed, the share and the absolute number of employees in the IT service sector grew significantly between 1995 to 2007. While in 1995, 0.66 percent of all employees in Germany were employed in the IT service sector, which corresponds to approximately 250 000 employees, this share rose constantly to 1.42 percent until 2007, which corresponds to to a total number of approximately 564 000 employees (see Figure A.1).

References

Addison, J., Schnabel, C. and Wagner, J. (2007). The (Parlous) State of German Unions, *Journal of Labor Research* **28**(1): 3–18.

Almus, M. and Nerlinger, E. (2002). Testing "Gibrat's Law" for Young Firms – Empirical Results for West Germany, *International Journal of Industrial Organization* **15**(1): 1–12.

Amiti, M. and Wei, S. (2009). Service Offshoring and Productivity: Evidence from the US, *World Economy* **32**(2): 203–220.

Blanchflower, D. and Burgess, S. (1998). New Technology and Jobs: Comparative Evidence from a two Country Study, *Economics of Innovation and New Technology* **5**(2–4): 109–138.

Brouwer, E., Kleinknecht, A. and Reijnen, J. (1993). Employment Growth and Innovation at the Firm Level – An Empirical Study, *Journal of Evolutionary Economics* **3**(2): 153–159.

Chongvilaivan, A., Hur, J. and Riyanto, Y. (2008). Outsourcing Types, Relative Wages, and the Demand for Skilled Workers: New Evidence from U.S. Manufacturing, *Economic Inquiry* **47**(1): 18–33.

Coad, A. (2007). Firm Growth: A Survey, *Working Paper 2007.24*, Centre d'Economie de la Sorbonne, Paris.

Davis, S. and Haltiwanger, J. (1992). Gross Job Creation, Gross Job Destruction, and Employment Reallocation, *Quarterly Journal of Economics* **107**(3): 819–863.

Dibbern, J., Goles, T., Hirschheim, R. and Jayatilaka, B. (2004). Information Systems Outsourcing: A Survey and Analysis of the Literature, *DATA BASE for Advances in Information Systems* **35**(4): 6–102.

DiRomualdo, A. and Gurbaxani, V. (1998). Strategic Intent for IT Outsourcing, *Sloan Management Review* **39**(4): 67–80.

Doms, M., Dunne, T. and Roberts, M. (1998). The Role of Technology Use in the Survival and Growth of Manufacturing Plants, *International Journal of Industrial Organization* **13**(4): 523–542.

Dunne, P. and Hughes, A. (1994). Age, Size, Growth and Survival: UK Companies in the 1980s, *Journal of Industrial Economics* **42**(2): 115–140.

Evans, D. (1987a). Alternative Theories of Firm Growth, *Journal of Political Economy* **95**(4): 657–674.

Evans, D. (1987b). The Relationship Between Firm Growth, Size, and Age: Estimates for 100 Manufacturing Industries, *Journal of Industrial Economics* **35**(4): 567–581.

Geroski, P. and Gugler, K. (2004). Corporate Growth Convergence in Europe, *Oxford Economic Papers* **56**(4): 597–620.

Goddard, J., Wilson, J. and Blandon, P. (2000). Panel tests of Gibrat's Law for Japanese manufacturing, *Small Business Economics* **20**(3): 415–433.

Gottschalk, P. and Solli-Saether, H. (2005). Critical Success Factors From IT Outsourcing Theories: An Empirical Study, *Industrial Management and Data Systems* **105**(6): 685–702.

Greenhalgh, C., Longland, M. and Bosworth, D. (2001). Technological Activity and Employment in a Panel of UK Firms, *Scottish Journal of Political Economy* **48**(3): 260–282.

Hall, B. (1985). The Relationship between Firm Size and Firm Growth in the U.S. Manufacturing Sector, *Journal of Industrial Economics* **35**(4): 583–606.

Han, K., Robert J.Kauffman and Nault, B. (2010). Returns to Information Technology Outsourcing, *Information System Research* .

Harhoff, D., Stahl, K. and Woywode, M. (1998). Legal Form, Growth and Exit of West German Firms – Empirical Results for Manufacturing, Construction, Trade and Service Industries, *Journal of Industrial Economics* **46**(4): 453–488.

Harrison, R., Jaumandreu, J., Mairesse, J. and Peters, B. (2008). Does Innovation Stimulate Employment? – A Firm-level Analysis Using Comparable Micro Data from Four European Countries, *Working Paper 14216*, National Bureau of Economic Research, Cambridge, MA.

Hart, P. and Oulton, N. (1996). Growth and the Size of Firms, *Economic Journal* **106**(438): 1242–1252.

Hijzen, A., Pisu, M., Upward, R. and Wright, P. (2007). Employment, Job Turnover and the Trade in Producer Services: Firm-level Evidence, *Research Paper 2007/37*, Leverhulme Centre, Nottingham.

Ichniowski, C., Kochan, T., Levine, D., Olson, C. and Strauss, G. (1996). What Works at Work: Overview and Assessment, *Industrial Relations* **35**(3): 299–333.

Jirjahn, U. (2009). Works Councils and Employment Growth in German Establishments, *Cambridge Journal of Economics* .

Kumar, M. (1985). Growth, Acquisition Activity and the Firm Size: Evidence from the United Kingdom, *Journal of Industrial Economics* **33**(3): 327–338.

Lacity, M., Khan, S. and Willcocks, L. (2009). A Review of the IT Outsourcing Literature: Insights for Practice, *Journal of Strategic Information Systems* **18**(3): 130–146.

Leonard, J. (1992). Unions and Employment Growth, *Industrial Relations* **31**(1): 80–94.

Loh, L. and Venkatraman, N. (1992a). Determinants of Information Technology Outsourcing: A Cross-Sectional Analysis, *Journal of Management Information Systems* **9**(1): 7–24.

Loh, L. and Venkatraman, N. (1992b). Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect, *Information Systems Research* **3**(4): 334–358.

Loh, L. and Venkatraman, N. (1995). An Empirical Study of Information Technology Outsourcing: Benefits, Risks and Performance Implications, *in* G. Ariav, C. Beath, J. DeGross, R. Hoyer and C. Kemerer (eds), *Proceedings of the Sixteenths International Conference on Information System*, ICIS, pp. 277–288.

Moser, C., Urban, D. and Weder di Mauro, B. (2009). Offshoring, Firm Performance and Establishment-Level Employment: Identifying Productivity and Downsizing Effects, *Discussion Paper 7455*, Centre for Economic Policy Research, London.

OECD (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, The Measurement of Scientific and Technological Activities, 3 edn, OECD Publishing, Paris.

Ohnemus, J. (2007). Does IT Outsourcing Increase Firm Success? An Empirical Assessment using Firm-Level Data, *Discussion Paper 07-087*, ZEW.

Smith, M., Mitra, S. and Narasimhan, S. (1998). Information System outsourcing: A Study of Pre-Event Firm Characteristics, *Journal of Management Information Systems* **15**(2): 61–93.

Smolny, W. (1998). Innovations, Prices and Employment: A Theoretical Model and an Empirical Application for West German Manufacturing Firms, *Journal of Industrial Economics* **46**(3): 359–381.

Van Reenen, J. (1997). Employment and Technological Innovation: Evidence from UK Manufacturing Firms, *Journal of Labor Economics* **15**(2): 255–284.

Variyam, J. and Kraybill, D. (1992). Empirical Evidence on Determinants of Firm Growth, *Economics Letters* **38**(1): 31–36.

Wang, L., Gwebu, K., Wang, J. and Zhu, D. (2008). The Aftermath of Information Technology Outsourcing: An Empirical Study of Firm Performance Following Outsourcing Decisions, *Journal of Information Systems* **22**(1): 125–159.

Wirthmann, A. and Smihily, M. (2007). Internet usage by enterprises 2007, *Data in Focus 25/2007*, Eurostat.

ZEW (2005). Internet bestimmt den Geschäftsalltag, *IKT-Report*, Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim.

ZEW (2010). Interaktiv, mobil, international – Unternehmen im Zeitalter von Web 2.0, *IKT-Report*, Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim.

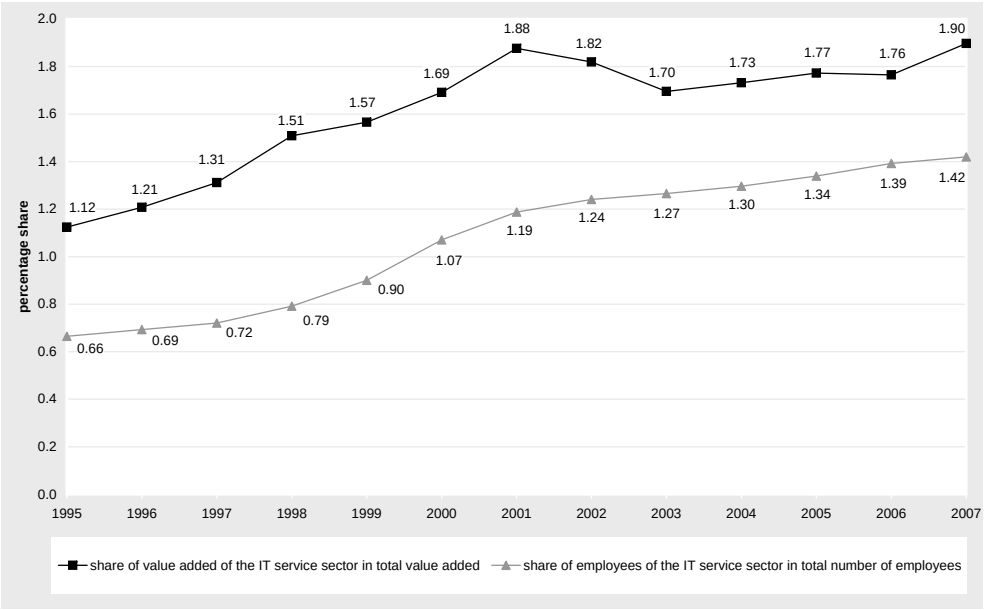
Appendix - Tables and Figures

Table A.1: Motivations for IT outsourcing

Motivation for IT outsourcing	**Description**	**Number of articles**
Cost reduction	A client organisation's need or desire to use outsourcing to reduce or control IS costs	39
Focus on core capabilities	A client organisation's desire or need to outsource in order to focus on its core capabilities	24
Access to expertise/skills	A client organisation's desire or need to access supplier(s) skills/expertise	18
Improve business/process performance	A client organisation's desire or need to engage a supplier to help improve a client's business, processes, or capabilities	17
Technical reasons	A client organisation's desire or need to gain access to leading edge technology through outsourcing	10
Flexibility	The ability to adapt to change	7
Political reasons	A client stakeholder's desire or need to use an outsourcing decision to promote personal agendas such as eliminating a burdensome function, enhancing their career, or maximising personal financial benefits	5
Change catalyst	A client organisation's desire or need to use outsourcing to bring about large scale changes in the organisation	4
Commercial exploitation	A client organisation's desire or need to partner with a supplier to commercially exploit existing client assets or form a new enterprise	3
Scalability	A client organisation's desire or need to outsource to be able to scale the volume of IS services based on demand	3
Access to global markets	A client organisation's desire or need to gain access to global markets by outsourcing to suppliers in those markets	2
Alignment of IS and business strategy	The fit or congruence between a firm's business strategy (conceptualised as defenders, prospectors, analysers) and its outsourcing strategy (e.g., arm's length, independent, and embedded)	2
Cost predictability	A client organisation's desire or need to use outsourcing to better predict IS costs	2
Headcount reduction	A client organisation's need or desire to use outsourcing to reduce the number of staff	2
Need to generate cash	A client organisation's desire or need to generate cash through the sale of IT assets to the supplier	2
Rapid delivery	A client organisation's desire or need to engage in outsourcing in order to speedup project delivery	2
Innovation	A client organisation's desire or need to use outsourcing as an engine for innovation	1
Total articles		*143*

Source: Lacity et al. (2009, p. 134).

Figure A.1: Share of employees (value added) from the IT service sector in total employees (value added) (Germany, 1995-2007)



Note: The IT service sector includes all firms belonging to NACE 72 (computer and related activities).
Source: The share of value added is base on input-output tables and the share of employees is based on Table 81000-0111, both provided by the Germany Statistical Office, and authors' calculations.

Table A.2: Descriptive statistics for manufacturing firms

	Manufacturing		IT outsourcing		non-IT outsourcing		Dummy
	Mean	**STD**	**Mean**	**STD**	**Mean**	**STD**	**variable**
employment growth rate	0.0048	0.0946	0.0053	0.1000	0.0045	0.0912	no
employees (2003)	193.4257	586.2686	197.6860	824.7872	190.8287	373.8096	no
size: 5-9 employees	0.1455	0.3529	0.1322	0.3394	0.1537	0.3611	yes
size: 10-19 employees	0.1346	0.3415	0.1488	0.3566	0.1259	0.3322	yes
size: 20-49 employees	0.1800	0.3845	0.2438	0.4303	0.1411	0.3485	yes
size: 50-249 employees	0.3787	0.4854	0.3678	0.4832	0.3854	0.4873	yes
size: $>$ 249 employees	0.1612	0.3680	0.1074	0.3103	0.1940	0.3959	yes
IT outsourcing	0.3787	0.4854	–	–	–	–	yes
Y2K consulting	0.5336	0.4993	0.6612	0.4743	0.4559	0.4987	yes
index standard wages	10.3397	0.8002	10.3264	0.7524	10.3479	0.8289	no
share university	0.1450	0.1808	0.1162	0.1523	0.1625	0.1943	no
share vocational	0.6034	0.2415	0.6248	0.2329	0.5904	0.2459	no
share computer employees	0.3311	0.2539	0.2755	0.2299	0.3650	0.2619	no
quality circle	0.4773	0.4999	0.4380	0.4972	0.5013	0.5006	yes
units w/ cost/profit resp.	0.2942	0.4560	0.2438	0.4303	0.3249	0.4689	yes
self dependent team	0.5728	0.4951	0.5455	0.4990	0.5894	0.4926	yes
exporter	0.7152	0.4517	0.6405	0.4808	0.7607	0.4272	yes
group of firms	0.2864	0.4524	0.2893	0.4544	0.2846	0.4518	yes
foreign subsidiary	0.1111	0.3145	0.0702	0.2561	0.1360	0.3432	yes
work council	0.4178	0.4936	0.3554	0.4796	0.4559	0.4987	yes
age: 0-3 years	0.0485	0.2150	0.0372	0.1896	0.0554	0.2291	yes
age: 4-7 years	0.1534	0.3606	0.1777	0.3830	0.1385	0.3459	yes
age: $>$ 7 years	0.7981	0.4017	0.7851	0.4116	0.8060	0.3959	yes
expected turnover	1.2629	0.7634	1.2769	0.7579	1.2544	0.7676	no
East Germany	0.2347	0.4242	0.2727	0.4463	0.2116	0.4089	yes
consumer goods	0.1643	0.3709	0.1818	0.3865	0.1537	0.3611	yes
chemical industry	0.0986	0.2983	0.1157	0.3205	0.0882	0.2839	yes
other raw materials	0.1362	0.3432	0.1612	0.3684	0.1209	0.3264	yes
metal and machine const.	0.1987	0.3994	0.1901	0.3932	0.2040	0.4035	yes
electrical engineering	0.1158	0.3202	0.0620	0.2416	0.1486	0.3562	yes
precision instruments	0.1831	0.3871	0.1777	0.3830	0.1864	0.3899	yes
automobile	0.1033	0.3046	0.1116	0.3155	0.0982	0.2980	yes
# of observations	639		242		397		

Note: All variables (if not indicated otherwise) refer to the years 2003 or 2004.
Source: ZEW ICT survey 2004, 2007 and own calculations.

Table A.3: Descriptive statistics for service firms

	Service		IT outsourcing		non-IT outsourcing		Dummy
	Mean	**STD**	**Mean**	**STD**	**Mean**	**STD**	**variable**
employment growth rate	0.0030	0.1362	0.0117	0.1420	-0.0030	0.1318	no
employees (2003)	167.0544	664.4435	112.9717	731.8495	204.8944	611.3091	no
size: 5-9 employees	0.2388	0.4268	0.2689	0.4444	0.2178	0.4134	yes
size: 10-19 employees	0.1981	0.3989	0.2453	0.4313	0.1650	0.3718	yes
size: 20-49 employees	0.2621	0.4402	0.3019	0.4602	0.2343	0.4243	yes
size: 50-249 employees	0.1709	0.3768	0.1321	0.3394	0.1980	0.3992	yes
size: $>$ 249 employees	0.1301	0.3367	0.0519	0.2223	0.1848	0.3888	yes
IT outsourcing	0.4117	0.4926	–	–	–	–	yes
Y2K consulting	0.5165	0.5002	0.6509	0.4778	0.4224	0.4948	yes
index standard wages	9.4911	1.0426	9.4925	0.9966	9.4901	1.0752	no
share university	0.2459	0.2817	0.1970	0.2499	0.2801	0.2976	no
share vocational	0.5932	0.2870	0.6414	0.2716	0.5594	0.2930	no
share computer employees	0.5661	0.3591	0.5372	0.3480	0.5864	0.3658	no
quality circle	0.3087	0.4624	0.2877	0.4538	0.3234	0.4686	yes
units w/ cost/profit resp.	0.3282	0.4700	0.3066	0.4622	0.3432	0.4756	yes
self dependent team	0.5806	0.4939	0.5566	0.4980	0.5974	0.4912	yes
exporter	0.2097	0.4075	0.1887	0.3922	0.2244	0.4179	yes
group of firms	0.3806	0.4860	0.3113	0.4641	0.4290	0.4958	yes
foreign subsidiary	0.0544	0.2270	0.0283	0.1662	0.0726	0.2599	yes
work council	0.2350	0.4244	0.1368	0.3444	0.3036	0.4606	yes
age: 0-3 years	0.0408	0.1980	0.0236	0.1521	0.0528	0.2240	yes
age: 4-7 years	0.1437	0.3511	0.1226	0.3288	0.1584	0.3657	yes
age: $>$ 7 years	0.8155	0.3882	0.8538	0.3542	0.7888	0.4089	yes
expected turnover	1.0951	0.7225	1.0943	0.6957	1.0957	0.7419	no
East Germany	0.2544	0.4359	0.2689	0.4444	0.2442	0.4303	yes
wholesale trade	0.1223	0.3280	0.1462	0.3542	0.1056	0.3078	yes
retail trade	0.1806	0.3850	0.2123	0.4099	0.1584	0.3657	yes
transport and postal serv.	0.1650	0.3716	0.1745	0.3805	0.1584	0.3657	yes
banks and insurances	0.1553	0.3626	0.1368	0.3444	0.1683	0.3748	yes
technical services	0.2000	0.4004	0.1321	0.3394	0.2475	0.4323	yes
other business-related serv.	0.1767	0.3818	0.1981	0.3995	0.1617	0.3688	yes
# of observations	515		212		303		

Note: All variables (if not indicated otherwise) refer to the years 2003 or 2004.
Source: ZEW ICT survey 2004, 2007 and own calculations.

Table A.4: IV estimation results for manufacturing firms

	Spec. 1		Spec. 2		Spec. 3	
	first	**second**	**first**	**second**	**first**	**second**
IT outsourcing		0.0347		0.0353		0.0342
		(0.0311)		(0.0314)		(0.0312)
Y2K consulting	0.2120***		0.2104***		0.2118***	
	(0.0401)		(0.0401)		(0.0396)	
index standard wages	0.0629**		0.0612*		0.0573*	
	(0.0316)		(0.0316)		(0.0314)	
log labour	0.0519	-0.0478***	0.0302	-0.0453***	0.0257	-0.0448***
	(0.0645)	(0.0137)	(0.0647)	(0.0139)	(0.0638)	(0.0139)
log labour squared	-0.0075	0.0043***	-0.0053	0.0041***	-0.0052	0.0040***
	(0.0080)	(0.0014)	(0.0080)	(0.0014)	(0.0079)	(0.0014)
share university			-0.2746**	0.0328	-0.1059	0.0181
			(0.1190)	(0.0290)	(0.1294)	(0.0332)
share vocational			-0.0479	0.0123	-0.0121	0.0091
			(0.0909)	(0.0183)	(0.0907)	(0.0186)
share computer employees					-0.2378***	0.0204
					(0.0795)	(0.0211)
quality circle	-0.0202	-0.0012	-0.0193	-0.0014	-0.0223	-0.0011
	(0.0403)	(0.0076)	(0.0402)	(0.0077)	(0.0399)	(0.0076)
units w/ cost/profit resp.	-0.0565	0.0002	-0.0418	-0.0016	-0.0330	-0.0024
	(0.0463)	(0.0090)	(0.0473)	(0.0090)	(0.0467)	(0.0089)
self dependent team	-0.0299	0.0050	-0.0339	0.0055	-0.0233	0.0046
	(0.0392)	(0.0079)	(0.0392)	(0.0079)	(0.0390)	(0.0078)
exporter	-0.1201**	0.0374***	-0.1032**	0.0360***	-0.0831*	0.0342***
	(0.0480)	(0.0104)	(0.0490)	(0.0104)	(0.0493)	(0.0101)
group of firms	0.0934*	0.0063	0.0931*	0.0059	0.0952*	0.0058
	(0.0524)	(0.0105)	(0.0526)	(0.0107)	(0.0525)	(0.0106)
foreign subsidiary	-0.1176	-0.0102	-0.1107	-0.0105	-0.1210	-0.0097
	(0.0787)	(0.0124)	(0.0791)	(0.0125)	(0.0787)	(0.0126)
work council	-0.0548	-0.0014	-0.0511	-0.0021	-0.0471	-0.0025
	(0.0528)	(0.0085)	(0.0528)	(0.0085)	(0.0523)	(0.0084)
age: 0-3 years	-0.0989	-0.0088	-0.0940	-0.0093	-0.0916	-0.0095
	(0.0878)	(0.0177)	(0.0861)	(0.0177)	(0.0879)	(0.0177)
age: 4-7 years	0.0952*	-0.0028	0.1024*	-0.0035	0.1029**	-0.0035
	(0.0528)	(0.0121)	(0.0529)	(0.0123)	(0.0523)	(0.0124)
expected turnover	0.0244	0.0280***	0.0295	0.0277***	0.0336	0.0273***
	(0.0246)	(0.0049)	(0.0250)	(0.0051)	(0.0249)	(0.0052)
East Germany	0.0479	0.0182*	0.0765	0.0145	0.0600	0.0159
	(0.0465)	(0.0095)	(0.0478)	(0.0100)	(0.0472)	(0.0100)
constant	-0.3760	0.0529*	-0.2724	0.0374	-0.2073	0.0358
	(0.3579)	(0.0300)	(0.3667)	(0.0362)	(0.3635)	(0.0366)
industry dummies	yes	yes	yes	yes	yes	yes
R^2	0.1139		0.1210		0.1320	
Sargan-test		0.1757		0.1697		0.1457
# of observations	639	639	639	639	639	639

Note: Dependent variable: employment growth rate (2003-2006). *,** and *** indicate significance at the 10%, 5% and 1% level respectively. Robust standard errors are reported in parentheses. Seven industry dummies are included in the regressions. For the Sargan-test, p-values are reported.
Source: ZEW ICT survey 2004, 2007 and own calculations.

Table A.5: IV estimation results for service firms

	Spec. 1		Spec. 2		Spec. 3	
	first	**second**	**first**	**second**	**first**	**second**
IT outsourcing		0.1104**		0.1045**		0.1046**
		(0.0534)		(0.0516)		(0.0515)
Y2K consulting	0.2444***		0.2493***		0.2493***	
	(0.0430)		(0.0427)		(0.0427)	
index standard wages	0.0766		0.0739		0.0739	
	(0.0481)		(0.0476)		(0.0479)	
log labour	-0.0377	-0.0460***	-0.0360	-0.0418***	-0.0360	-0.0418***
	(0.0577)	(0.0153)	(0.0568)	(0.0150)	(0.0569)	(0.0151)
log labour squared	-0.0030	0.0047***	-0.0036	0.0044***	-0.0036	0.0044***
	(0.0069)	(0.0017)	(0.0068)	(0.0016)	(0.0068)	(0.0016)
share university			-0.1991	0.0530	-0.1997	0.0531
			(0.1304)	(0.0432)	(0.1339)	(0.0448)
share vocational			0.0596	0.0620	0.0593	0.0620
			(0.1113)	(0.0382)	(0.1122)	(0.0383)
share computer employees					0.0011	-0.0002
					(0.0771)	(0.0199)
quality circle	0.0422	0.0336**	0.0406	0.0343**	0.0406	0.0343**
	(0.0477)	(0.0135)	(0.0473)	(0.0133)	(0.0476)	(0.0133)
units w/ cost/profit resp.	0.0426	0.0254	0.0389	0.0245	0.0389	0.0245
	(0.0500)	(0.0166)	(0.0497)	(0.0164)	(0.0497)	(0.0164)
self dependent team	-0.0272	-0.0348**	-0.0176	-0.0367***	-0.0177	-0.0367**
	(0.0450)	(0.0137)	(0.0450)	(0.0141)	(0.0455)	(0.0143)
exporter	-0.0018	-0.0112	0.0065	-0.0123	0.0065	-0.0123
	(0.0518)	(0.0166)	(0.0517)	(0.0164)	(0.0517)	(0.0164)
group of firms	-0.0556	0.0130	-0.0600	0.0128	-0.0600	0.0128
	(0.0486)	(0.0168)	(0.0486)	(0.0166)	(0.0487)	(0.0166)
foreign subsidiary	-0.0460	0.0079	-0.0089	0.0090	-0.0090	0.0090
	(0.1017)	(0.0358)	(0.1030)	(0.0340)	(0.1035)	(0.0342)
work council	-0.1331**	0.0264	-0.1314**	0.0253	-0.1314**	0.0253
	(0.0653)	(0.0168)	(0.0648)	(0.0164)	(0.0649)	(0.0163)
age: 0-3 years	-0.2371**	0.0527*	-0.2675***	0.0477	-0.2675***	0.0477
	(0.0959)	(0.0301)	(0.0971)	(0.0308)	(0.0974)	(0.0308)
age: 4-7 years	-0.0752	-0.0061	-0.0780	-0.0059	-0.0780	-0.0059
	(0.0588)	(0.0234)	(0.0592)	(0.0234)	(0.0592)	(0.0234)
expected turnover	0.0128	0.0063	0.0078	0.0060	0.0078	0.0060
	(0.0288)	(0.0095)	(0.0288)	(0.0096)	(0.0289)	(0.0095)
East Germany	0.0321	-0.0090	0.0307	-0.0114	0.0308	-0.0115
	(0.0505)	(0.0150)	(0.0503)	(0.0147)	(0.0508)	(0.0147)
constant	-0.2143	0.0405	-0.1579	-0.0098	-0.1580	-0.0097
	(0.4758)	(0.0425)	(0.4832)	(0.0555)	(0.4837)	(0.0563)
industry dummies	yes	yes	yes	yes	yes	yes
R^2	0.1645		0.1759		0.1759	
Sargan-test		0.2168		0.1964		0.1954
# of observations	515	515	515	515	515	515

Note: Dependent variable: employment growth rate (2003-2006). *,** and *** indicate significance at the 10%, 5% and 1% level respectively. Robust standard errors are reported in parentheses. Six industry dummies are included in the regressions. For the Sargan-test, p-value are reported.
Source: ZEW ICT survey 2004, 2007 and own calculations.

Table A.6: Industry classification

Industry	Explanation	NACE
consumer goods		
	manufacture of food products, beverages and tobacco	15-16
	manufacture of textiles and textile products	17-18
	manufacturing of leather and leather products	19
	manufacture of wood and wood products	20
	manufacturing of pulp, paper and paper products; publishing and printing	21-22
	manufacturing n.e.c.	36-37
chemical industry		
	manufacture of coke, refined petroleum products and nuclear fuel	23
	manufacture of chemicals, chemical products and man-made fibres	24
other raw materials		
	manufacture of rubber and plastic products	25
	manufacture of non-metallic mineral products	26
	manufacture of basic metal	27
metal and machine construction		
	manufacture of fabricated metal products (except machinery and equipment)	28
	manufacture of machinery and equipment n.e.c.	29
electrical engineering		
	manufacture of office machinery and computers	30
	manufacture of electrical machinery and apparatus n.e.c.	31
	manufacture of radio, television and communication equipment and apparatus	32
precision instruments		
	manufacture of medical, precision and optical instruments, watches and clocks	33
automobile		
	manufacturing of transport equipment	34-35
wholesale trade		
	wholesale trade and commission trade (except of motor vehicles and motorcycles)	51
retail trade		
	sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50
	retail trade (except of motor vehicles and motorcycles), repair of personal and household goods	52
transportation and postal services		
	land transport, transport via pipeline	60
	water transport	61
	air transport	62
	supporting and auxiliary transport activities; activities of travel agencies	63
	post and courier activities	64.1
banks and insurances		
	financial intermediation	65-67
technical services		
	research and development	73
	architectural and engineering activities and related technical consultancy	74.2
	technical testing and analysis	74.3
other business-related services		
	real estate activities	70
	renting of machinery without operator and of personal and household goods	71
	legal, accounting, book keeping and auditing activities; tax consultancy; market research and public opinion pools; business and management consultancy; holdings	74.1
	advertising	74.4
	labour recruitment and provision of personnel	74.5
	investigation and security services	74.6
	industrial cleaning	74.7
	miscellaneous business activities n.e.c.	74.8
	sewage and refuse disposal, sanitation and similar activities	90