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Michael Beckmann, Dieter Kuhn

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The Author(s):

Prof. Dr. Michael Beckmann

Department of Human Resources and Organization (WWZ), University of Basel

Peter Merian-Weg 6

CH - 4002 Basel

michael.beckmann@unibas.ch

Dieter Kuhn, Assistant

Department of Human Resources and Organization (WWZ), University of Basel

Peter Merian-Weg 6

CH - 4002 Basel

dieter.kuhn@unibas.ch

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Contact:
WWZ Forum | Peter Merian-Weg 6 | CH-4002 Basel | forum-wwz@unibas.ch | www.wwz.unibas.ch

Temporary Agency Work and Firm Performance: Evidence from German Establishment-Level Panel Data

Michael Beckmann*, Dieter Kuhn**

** University of Basel, Center of Business and Economics, Department for Human Resources and Organization, Peter Merian-Weg 6, CH-4002 Basel, Switzerland, Phone: +41-(0)61-267 32 24, E-Mail: michael.beckmann@unibas.ch*

*** University of Basel, Center of Business and Economics, Department for Human Resources and Organization, Peter Merian-Weg 6, CH-4002 Basel, Switzerland, Phone: +41-(0)61-267 32 26, E-Mail: dieter.kuhn@unibas.ch*

Abstract

This paper empirically examines the impact of temporary agency work on firm performance using panel data from German establishments. Thereby, special attention is devoted to the question, whether there are performance differences between firms using temporary agency workers (TAWs) as a buffer stock (flexibility strategy) and firms using TAWs for screening purposes (screening strategy). While the theoretical discussion on this issue does not lead to clear-cut results, our empirical investigation provides the following results. First, we find an inverse U-shaped relationship between the share of TAWs and firm performance. Second, we obtain that firms following the screening strategy are significantly more productive than firms following the flexibility strategy. These results are found to be valid in both cross-sectional and panel data settings, so they are robust to unobserved firm heterogeneity.

JEL Classification: C23; J24; J42; J82; M55

Keywords: Temporary agency work, firm performance, flexibility strategy, screening strategy

1. Introduction

In recent years, the growth in the temporary agency industry has been tremendous – irrespective of the level of employment protection legislation (EPL). For example, both Germany and Switzerland – the former known as a country with a rather high level of EPL, the latter rather known as a low EPL-level country – have witnessed a growth of 10 % p. a. in the number of temporary agency workers (TAWs) over the past 10 years. In 2007 more than 700'000 TAWs were employed in German firms, corresponding to about 1 % of the total labor force (Gerwien 2008). In trying to explain this development, literature points to changes in external forces boosting the demand for TAWs. These chances contain a growing competition and the need for flexibility and cutting costs (Kirk and Belovics 2008), a distinct EPL, which can be avoided by employing TAWs (Hagen and Boockmann 2002), and deregulation tendencies in the temporary agency sector relaxing the requirements to employ TAWs (MacPhail and Bowles 2008).

We refer to temporary work as the triangular relationship between a TAW, a temporary work agency and a client firm, whose performance is being examined in this paper. The agency is the de jure employer of the worker. Therefore, the agency pays the wage (Mitlacher 2005) and keeps disciplinary authority over the TAW (Bianchi/Lampart 2007). The agency lends the TAW to a client firm, which in turn pays a fee to the agency. Therefore, the client firm has got managerial authority over the TAW. According to Föhr (2000), temporary work agencies help to reduce transaction costs (e.g. search costs and bargaining costs) between client firms and workers.[1] This is especially true in the case of specific human capital, i.e. in case of employees with further vocational training. Additionally, temporary work agencies can specialize in HR tasks such as developing better screening tests or attracting a larger pool of candidates.

There are two main reasons why client firms hire TAWs (Forde, MacKenzie and Robinson 2008): flexibility and screening. For example, firms can use TAWs to meet short-term fluctuations in demand, i.e. to enhance their flexibility (Boockmann and Hagen 2001). In this case, TAWs serve as a buffer allowing short-term employment adjustments without affecting

[1] For example, client firms do not need to place an advertisement in a newspaper or on the internet. Furthermore, they do not necessarily need to interview and sometimes even select applicants. These (pre-)selection activities are typically delegated to the temporary work agencies.

permanent employees (Booth, Francesconi and Frank 2002b). On the other hand, firms can also use TAWs to screen workers before hiring them on a permanent basis (Pfeifer 2006). In that case, firms signal a long-term interest to TAWs, because temporary work may constitute a stepping stone for them into permanent employment (Barbieri and Sestito 2008, Booth, Francesconi and Frank 2002a).

These diverging strategies could have different effects on firm performance. For example, by following a flexibility strategy a firm could at first maintain a continuing production in spite of a potential short-term labor shortage (Bryson 2007). Moreover, the firm is also able to respond to fluctuations in demand flexibly and at low cost (Kirk and Belovics 2008). As a result, these benefits of flexibility may increase firm performance. On the other hand, firms using TAWs as a buffer stock internally implement a dual labor market consisting of permanent core workers and flexible temporary workers, whose employment opportunities are subject to demand fluctuations (Booth, Francesconi and Frank 2002b). This could deteriorate the motivation of TAWs and thus affect a firm's productivity.

On the contrary, the application of the screening strategy may be associated with positive motivation and productivity effects, because the TAWs have the option to be promoted to a permanent job, when the screening process ends up in a positive evaluation (Engellandt und Riphahn 2005). On the other hand, however, negative spill-over effects may be opposed to the intention of the screening strategy. These effects may occur, when permanent employees feel threatened to be replaced by hard working TAWs. In this case, permanent workers are likely to cut down on their willingness to cooperate with TAWs (Martins and Lima 2006; Chattopadhyay and George 2001). Hence, the screening strategy may also involve adverse firm performance effects.

The objective of our paper is twofold: First, we aim at empirically examining the impact of temporary work on firm performance in Germany. Specifically, we are interested in examining the productivity effects as well as the motivation effects of TAW use. Previous studies have focussed on the productivity effects of temporary work in other countries and have come to mixed or insignificant results (Bryson 2007; Arvanitis 2005; Kleinknecht et al. 2006). Second, we want to address the issue of whether there are performance differences between firms using temporary work as a buffer stock and firms that use it for screening

purposes. To the best of our knowledge, this question has not been tackled by other studies before.

For this purpose, we use data of the Institute for Employment Research (IAB) establishment panel (waves 2000-2005). At first, we run OLS, fixed and random effects regressions in order to estimate the productivity and motivation effects of TAW use. Thereby, we are able to correct for unobserved firm heterogeneity. Additionally, we apply a two-step-procedure proposed by Black and Lynch (2001) in order to discriminate between the productivity effects of the flexibility and the screening strategy. Our respective empirical model is an augmented Cobb-Douglas production function. The estimation results allow the derivation of management implications for the effective use of temporary agency workers.

The remainder of this paper is organized as follows. Section 2 provides the theoretical background of this study. In Section 3 we shortly discuss the related empirical literature. Section 4 contains our empirical investigation. At first, we introduce the dataset and our main variables and present some descriptive results. Subsequently, we explain the econometric modelling and the results regarding the productivity effects of TAW use. We proceed analogously with respect to the productivity effects of TAW use in firms following the flexibility or the screening strategy, respectively. Finally, Section 5 concludes.

2. Theoretical Background

The employment of TAWs may be economically interesting for client firms for at least two reasons (Forde, MacKenzie and Robinson 2008). First, TAWs enable firms to meet their flexibility requirements more effectively than the alternative employment of permanent workers. Second, the use of TAWs provides firms with an additional screening device to reduce the typical pre-contractual principal-agent information problem with respect to the abilities and motivation of the workers to be recruited. In this sense, the employment of TAWs serves as a prolonged probation period, in which the firm has the opportunity to obtain the necessary information. We refer to the first motive for employing TAWs as *flexibility strategy*, while we call the second motive just mentioned *screening strategy*.

The use of TAWs may increase the flexibility of client firms, because TAWs allow these firms to rapidly respond to demand fluctuations and staff shortages (Hagen and Boockmann

2002; Kirk and Belovics 2008). For example, in times of labor shortage temporary work agencies are able to provide the firms concerned with TAWs in the short run. In this way, the flexible use of TAWs allows firms to maintain an uninterrupted production. This is important not only because production technology can be applied continuously and at high capacity, but also because customers can be served in due time (Bryson 2007). Additionally, in times of increasing demand firms may prefer to extend their workforce employing TAWs instead of permanent employees, because the separation from TAWs is usually much easier than the dismissal of permanent employees, when demand declines. Hence, employing TAWs offer firms an opportunity to flexibly adjust their workforce in response to demand requirements. The flexibility argument is even amplified in countries with a high level of EPL, since employing TAWs instead of permanent workers allows firms to save dismissal costs. Specifically, TAWs can easily be dismissed without dismissal costs sending the TAWs back to the temporary work agency, while the dismissal of permanent employees typically requires the adherence of cancellation periods and substantial severance payments. Finally, firms employing TAWs are able to realize cost benefits relative to employing permanent workers. A direct cost advantage results from the fact that TAWs typically receive significant lower wages than permanent workers, while an indirect benefit cost effect can be achieved by putting pressure on the wages of all employees (Bryson 2007). Summing up, these benefits of flexibility are likely to have a positive effect on firm performance.

On the other hand, firms following the flexibility motive internally implement a dual labor market consisting of privileged permanent employees in a secure position and precarious TAWs sitting in a trap (Pfeifer 2006). Moreover, TAWs usually experience lower wages, poorer working conditions and less training than permanent employees (Nienhüser and Matiaske 2006).[2] When TAWs recognize that permanent workers are much better off with respect to several important job characteristics than TAWs, although both types of workers execute similar tasks, this relative job discrimination could reduce TAWs' effort, motivation and productivity and may even deteriorate the cooperation with permanent employees. Following this line of reasoning, the flexibility strategy is likely to have a negative effect on firm performance.

Alternatively, by following a screening strategy a firm may increase the motivation, effort level and productivity of TAWs. The reason for this is that – contrary to the flexibility

[2] Additionally, Amuedo-Dorantes (2002) finds that TAWs exhibit significantly higher work injury and illness rates.

strategy – the screening strategy implies the possibility of a long-term perspective for the TAWs. While temporary work in firms following the flexibility motive can be thought of being a 'dead end' for the TAWs concerned, it may serve as a 'stepping stone' for TAWs working in firms following the screening motive.[3] In these firms, namely, TAWs are initially employed under the usual conditions of temporary agency work, but are offered a permanent job, after having proven their worth. This option may enhance to TAWs motivation and effort level.

The rationale for applying the screening strategy can be explained using classical results of the principal agent and tournament theory. It is well-known from the principal agent literature that employers usually face a pre-contractual information problem with respect to unobserved individual worker characteristics, such as ability and motivation. The employment of TAWs may represent a possible solution to this information problem. An employer may prefer to initially employ a TAW instead of a permanent worker, because this allows him to gain the required information. In that way, temporary agency work can be thought of representing a prolonged probation period enabling the employer to improve his recruitment decisions, which corresponds to reducing the cost of wrong employment decisions, i.e. the costs of hiring unable workers. If a TAW is positively evaluated after the screening process, he will be promoted to a permanent position, while he has to leave the firm in the converse case of a negative evaluation. Proceeding that way the employer in the end initializes a job tournament between the TAWs, where the winner prize is a permanent job and losers have to leave the firm.

It is well-known from the tournament literature that tournaments do not only exhibit a selection function but also an incentive function (e.g. Lazear and Gibbs 2008; Garibaldi 2006). In general, tournaments are intended to encourage workers to spend high effort, when the winner prize is high relative to the loser prize. In the present case, there is a winner-takes-all-situation, because the positively evaluated TAWs are offered a permanent job, while the negatively evaluated TAWs have to leave the firm. Hence, the wage differential between positively and negatively evaluated TAWs is likely to be sufficiently large to generate high effort levels among the competing TAWs. As a consequence, the screening strategy is supposed to have a positive effect on firm performance.

[3] The terms 'dead end' and 'stepping stone' can be ascribed to Booth, Francesconi and Frank (2002a).

On the other hand, applying the screening strategy may also be associated with substantial drawbacks calling the reasoning just mentioned into question. For example, permanent workers may perceive the job tournament among the TAWs as a threat for their own jobs, which virtually should be quite secure by definition (Martins and Lima 2006; Bryson 2007). More precisely, permanent workers may worry about their own jobs, because they cannot definitely rule out the possibility to be replaced by successful TAWs, even if this is not the primary intention of the up or out-tournament. In this case, peer relations are likely to deteriorate because permanent workers might refuse to cooperate with TAWs (Chattopadhyay and George 2001). Hence, work organization could substantially be affected. Furthermore, worker-manager relations and the loyalty between those two parties could also worsen, encouraging permanent employees to quit, and thus, increasing the turnover rate of the firm (Davis-Blake, Broschak and George 2003). As a consequence, these negative spill-over effects on permanent employees may involve a negative effect on firm performance.

All in all, the theoretical discussion with respect to the effect of TAWs on firm performance is heterogeneous. Both the flexibility strategy and the screening strategy may be associated with positive or negative performance effects, while the relative effect of the two strategies remains an open question. Our empirical analysis, therefore, aims at sheding light on this issue. More precisely, we first estimate the general effect of temporary agency work on firm performance. Our second objective is to estimate whether there are productivity differences between firms following the flexibility strategy and those following the screening strategy. Before turning to the empirical analysis, however, we provide a brief review of the related empirical literature.

3. Related Literature

Several authors address the benefits of the screening strategy, however, without comparing it to the flexibility strategy. For example, Erickcek, Houseman and Kalleberg (2002) conduct case studies of 18 Midwestern firms in manufacturing, health care and education. They find that temporary agency work has less negative or even positive effects for TAWs, if the client firm follows a screening strategy, which offers a long-term perspective to the TAWs. Moreover, Tan and Tan (2002) empirically examine the determinants of job satisfaction among 141 TAWs of four Singaporean temporary work agencies. They find that involuntary TAWs – i.e. those TAWs that virtually prefer and thus primarily seek a permanent job, but

have accepted a contract with a temporary work agency for the present – work extra hard in order to signal their capabilities. On the basis of 174 TAWs of a Midwestern agency, Ellingson, Gruys and Sackett (1998) find that involuntary TAWs indeed exhibit a lower level of satisfaction than voluntary TAWs; their productivity, however, is not significantly affected. Neither Tan and Tan (2002) nor Ellingson, Gruys and Sackett (1998) mention the screening strategy explicitly, but there seems to be an evident relationship. Consequently, tournaments among TAWs can serve as a meaningful and efficient method for screening new employees.

Turning to cross sectional studies on productivity effects of TAWs at the establishment level, the results are mixed. For example, Arvanitis (2005) uses a nationally representative sample of 1,382 Swiss firms covering all sectors and firm sizes in order to investigate the impact of functional and numerical flexibility on firm performance and innovation activity. In his OLS-regression, he finds a positive, but insignificant effect of temporary agency work on sales per capita, where temporary agency work is a dummy variable indicating whether or not temporary agency work is an important HR practice in that firm.

Kleinknecht et al. (2006) use a dataset, which has been collected by the "Organisation for Strategic Labour Market Research" (OSA) of the Netherlands and includes 590 firms from a wide range of sectors (e.g. manufacturing, agriculture, services, and non-commercial services). Apparently applying OLS, they find a positive, but insignificant effect of the percentage of hours hired from temporary work agencies on sales growth. However, they find a significantly positive effect on sales growth in firms with some R&D activities.

Bryson (2007) uses the 2004 Workplace Employment Relations Survey, which is a nationally representative sample of 2,295 British establishments with five or more employees from a wide range of sectors. In a first step, the author finds that TAW presence in a workplace is associated with significant 30 % higher sales per employee. In a second step, measuring the extent of TAW use, none of the two dummy variables – one covering workplaces with 1-4 % TAWs, the other covering workplaces with more than 5 % TAWs – is significantly different from zero in explaining sales per capita or value added per capita. However, an alternative subjective measure of labor productivity, which is intended to capture labor productivity

relative to other establishments belonging to the same industry, is significantly affected in firms employing 1-4 % TAWs.[4]

Given these mixed and less clear-cut results, the empirical evidence so far is not able to shed light on the productivity effects of temporary agency work. In addition, it must be mentioned that the previously discussed studies suffer from an important drawback. Neither of the studies, namely, accounts for unobserved firm heterogeneity. As a consequence, the estimated productivity effects of temporary agency work cannot be interpreted as causal effects, but represent simple correlations. A prominent example for unobserved firm heterogeneity is management quality. Provided that high sale firms employ more experienced or better qualified managers and that those managers simultaneously tend to employ more (or less) TAWs than their less qualified counterparts, temporary agency work cannot be assumed an exogenous explanatory variable. As a result, OLS estimates are likely to be biased and inconsistent. Therefore, an important objective of our empirical investigation is to control for unobserved firm characteristics using panel data and applying appropriate estimation methods. Furthermore, contrary to previous studies we aim at discriminating between the productivity effects of firms following the flexibility strategy relative to firms following the screening strategy. In this sense, our paper should add substantially to the empirical literature on the effects of temporary agency work on firm performance.

4. Empirical Investigation

4.1 Data, Variables and Descriptive Statistics

In our study, we use the data of the Institute for Employment Research (IAB) Establishment Panel. The IAB Establishment Panel is an annual survey of over 15,000 establishments in Germany. The establishments are selected from a parent sample of all German establishments that employ at least one employee covered by social security. This parent sample can be considered as complete, because establishments have to report on their employees under social security by law. The selection method is stratification with respect to ten categories of establishment size and 16 economic sectors. This is why an establishment's probability of

[4] Martins and Lima (2006) find a negative relationship between the share of top managers recruited from outside and labor productivity. Although this result does not deal with TAWs, the principle behind is similar in a way that the issue in both cases is recruiting from outside instead of promotion from within.

being selected increases with employment. Hence, the IAB establishment panel is approximately proportional to employment and therefore representative for the German economy. A large set of questions are covered periodically, such as employment and wages, sales, investments, export, R&D, innovations, organizational change, and vocational training (Bellmann, Kohaut and Lahner 2002). Additionally, special topics are covered by the questionnaire every year. For example temporary agency work is covered quite extensively in 2003.

The dependent variables are log sales measured in euro (*lnY*) and a variable indicating the extent of motivation problems in the establishment (*mot*). The latter is being constructed by summing up four dummy variables reflecting the interviewed firm representative's expectation about the existence of "a lack of labor motivation", "a high level of fluctuation", "a high level of absenteeism" and some "migration of high-skilled workers". Thus, the variable *mot* can theoretically take values from zero to four.[5]

The key explanatory variable for the first research question – performance effects of temporary agency work – is the share of TAWs relative to total employment (*temp*).[6] Apart form the original variable the estimation model does also contain the quadratic term (*temp_2*) to capture non-linearities. In order to provide an alternative specification, establishments were sorted into categories, depending on whether TAWs make up zero percent (*temp1*), 1-10 % (*temp2*), 11-30 % (*temp3*) or more than 30 % (*temp4*) of total employment. These dummy variables *temp1-temp4* indicate the affiliation of an establishment to one of these categories.

The key explanatory variables for the second research question – flexibility vs. screening strategy – are dummy variables indicating whether an establishment uses temporary agency work as a flexibility device (*flex*) or as a screening device (*screen*) or whether an

[5] One could also construct two alternative motivation problem variables. First, one could just use the dummy variable "lack of labor motivation" as dependent variable because it directly tackles the core problem considered here, namely motivation problems at work. However, this variable would neglect indirect consequences of a lack of motivation, which can be evident through high levels of absenteeism and fluctuation, especially in the case of high-skilled workers, whose outside options are often better than those of less skilled workers. Second, one could construct a dummy variable which takes the value one if one of the four indicators mentioned above, i.e. "lack of labor motivation", "high level of fluctuation", "high level of absenteeism" and "migration of high-skilled workers", is valid and zero otherwise. However, this alternative would not capture the quantitative extent of motivational problems. Irrespective of this objection, we also ran regressions using these two alternative variables. The estimates do not differ in sign and significance from those presented later in this paper.

[6] Total employment means regular employees plus TAWs minus fractionally employed persons (these are employees who are on the payroll of the establishment but earn less than 400 euro per month).

establishment follows a dual strategy (*fl_sc*).[7] Proceeding that way, only those establishments using TAWs at all are considered in the analysis. Firms have been regarded as flexibility establishments, if they usually adjust their workforce using TAWs to meet unexpected fluctuations in demand or production. On the other hand, firms have been regarded as screening establishments, if they have recently promoted workers that had previously been employed as TAWs to a permanent position. These questions allow for a direct classification without relying on indirect indicator variables.[8]

Finally, we use the following control variables: the natural logarithm of total investments (*lnK*) as an indicator for the establishments' capital stock, the natural logarithm of total employment (*lnL*), the share of high-skilled workers relative to regular employment (*qual*), outsourcing or insourcing activities of an establishment measured on a 0 to 4 scale and standardized (*orga1_std*), the state of the technical equipment measured on a 1 to 5 scale and standardized (*tech_std*), a dummy variable indicating whether or not a firm has invested in information and communication technologies (*ikt*), a dummy variable indicating the existence of a collective wage agreement on establishment or industry level (*wageset*), a dummy variable indicating the existence of a work council (*council*), two dummy variables indicating whether an establishment belongs to a non-incorporated (*noninc*) or incorporated firm (*inc*)[9], a dummy variable indicating whether an establishment has been founded before 1990 (*old*), a dummy variable indicating whether or not an establishment is held by foreign owners (*foreign*), the share of exports relative to total sales (*export*), as well as controls for the 16 German federal states (*reg1-reg16*) and for nine industry and service sectors (*sector1-sector9*).

Control variables only being available for 2004 are: a dummy variable indicating whether an establishment has offered continuous training to its employees either by paying the costs or by special company leave (*training*), a 0 to 10 scaled variable (standardized) indicating the extent

[7] The reference category consists of establishments without affiliation to either of these strategies.
[8] Alternatively, establishments could be identified as flexibility establishments, if using TAWs is their most important measure to meet short-term fluctuations. A second possibility, proposed by Binz (2007), would be to use a high share of TAWs to identify flexibility establishments and a high share of former TAWs that have now been promoted to a permanent position to identify screening establishments. Both alternatives have been additionally applied. The estimates do not differ in sign and significance from those presented later in this paper.
[9] Reference categories for *noninc* and *inc* are special organizations, such as public bureaus, membership associations or cooperative societies.

of organizational changes undertaken by an establishment (*orga2_std*)[10], a dummy variable indicating whether an establishment offers pay for performance applying stock ownership plans or profit sharing (*incentive*), a variable of product innovation (measured on a 0 to 3 scale and standardized) indicating whether products have been improved, newly integrated into the range of existing products or completely new developed (*inno_std*).[11] Table 1 provides an overview of the most important descriptive statistics of the key variables.[12]

[Insert Table 1 about here]

4.2 Productivity and Motivation Effects of Temporary Agency Work

4.2.1 Econometric Model

In order to examine the productivity effects of temporary agency work, we estimate a Cobb-Douglas production function which is augmented by the share of temporary agency workers relative to total employment (*temp*), the quadratic term (*temp_2*) and the control variables *X* introduced above. An alternative specification includes dummy variables instead of *temp* and *temp_2*. These dummy variables indicate whether an establishment employs 1-10 % TAWs (*temp2*), 11-30 % TAWs (*temp3*) or more than 30 % TAWs (*temp4*). The reference group represent those firms without TAWs.[13] Both specifications are formally displayed in equations (1a) and 1b):

$$\ln Y_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \gamma_1 temp_{it} + \gamma_2 temp\_2_{it} + \sum_{j=1}^{n} \delta_j X_{it\,j} + u_{it} \quad , \qquad (1a)$$

[10] These organizational changes include the reorganization of the supply chain, the improvement of quality management, improvements of ecological standards, an increase of the grade of decentralization, the introduction of team work, the introduction of profit centers, and the reorganization of departments.

[11] See Binz (2007) concerning selection, description and justification of the control variable used.

[12] Tables 5 and 6 in the appendix provide the definitions and descriptive statistics of the complete set of variables used in this study.

[13] This procedure is common in the literature we refer to (e.g. Kleinknecht et al. 2006; Bryson 2007). Arvanitis (2005) uses a five-point Likert scale variable indicating whether or not temporary work is important. The exact limits of 10 % and 30 %, respectively, are not arbitrarily chosen. As the results (see Table 2) will show, the level of 10 % approximately corresponds to the optimum of the production function (1a) estimated with fixed effects, while the level of 30 % approximates the second null of the parabola. As a complement to these specifications, we also ran a model splitting the input factor labor into two parts, namely regular and temporary agency workers. Splitting input factors in the context of a Cobb-Douglas production function (capital, labor) has been used in many fields (see e.g. Acemoglu 2002). The results – not reported in this paper – show that the elasticity of regular workers is significantly and by far larger than that of TAWs. Perhaps, further examinations of such relationships lead to more detailed explanations in terms of the course of the production function discovered in Table 2.

$$\ln Y_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{k=2}^{4} \gamma_k temp_{itk} + \sum_{j=1}^{n} \delta_j X_{it\,j} + u_{it} \quad , \tag{1b}$$

where *Y* is total sales, *K* represents capital stock, *L* describes labor, and *u* is a i. i. d. random variable (*i* is the establishment index, *t* is the time index). At first, we employ pooled OLS using the waves 2002-2005 and applying heteroscedasticity-robust standard errors according to White (1980).

Since we argue that a high share of TAWs could constitute motivation problems within the workforce, we explain motivation problems (*mot*) using the same augmented Cobb-Douglas production function, where *lnY* is replaced by *mot*:

$$mot_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \gamma_1 temp_{it} + \gamma_2 temp\_2_{it} + \sum_{j=1}^{n} \delta_j X_{it\,j} + u_{it} \quad , \tag{2a}$$

$$mot_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{k=2}^{4} \gamma_k temp_{itk} + \sum_{j=1}^{n} \delta_j X_{it\,j} + u_{it} \quad . \tag{2b}$$

The variable *mot* is censored at zero. It takes the value zero in 76 % of all cases. Hence, applying a tobit maximum likelihood estimator is the appropriate estimation procedure.[14] Limited data availability restricts us to use the waves 2002, 2004 and 2005.

Cross sectional and pooled OLS estimations can be biased, if some time-invariant unobserved factors v_i influence the dependent variable and one or more explanatory variables simultaneously. In this case, the concerned explanatory variables can no longer considered exogenous, so OLS looses its BLUE-characteristics. As discussed above, a prominent example for unobserved firm heterogeneity is management quality. In order to control for such unobserved firm characteristics we use panel estimation methods, i.e., we estimate fixed effects and random effects models. Proceeding that way, we can exploit the (unbalanced) panel structure of our data. The equations to be estimated are:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \gamma_1 temp_{it} + \gamma_2 temp\_2_{it} + \sum_{j=1}^{n} \delta_j X_{it\,j} + v_i + u_{it} \quad , \tag{3a}$$

$$\ln Y_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{k=2}^{4} \gamma_k temp_{itk} + \sum_{j=1}^{n} \delta_j X_{it\,j} + v_i + u_{it} \tag{3b}$$

and

[14] We also applied ordered probit and ordered logit models yielding qualitatively similar results.

$$mot_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \gamma_1 temp_{it} + \gamma_2 temp\_2_{it} + \sum_{j=1}^{n} \delta_j X_{it\,j} + v_i + u_{it}\,, \quad (4a)$$

$$mot_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{k=2}^{4} \gamma_k temp_{itk} + \sum_{j=1}^{n} \delta_j X_{it\,j} + v_i + u_{it}\,. \quad (4b)$$

4.2.2 Empirical Results

Table 2 contains the pooled OLS, fixed effects and random effects estimates of the productivity effects of temporary agency work for each of the two specifications. More precisely, columns 1-3 display the results for the TAW share specification, while columns 4-6 display the results for the dummy variable specification. For both specifications the Breusch-Pagan-test cannot reject a significant explanation power of the establishment-specific effects. The also applied Hausman-tests support the fixed effects models (columns 2 and 5) compared to the random effects models (columns 3 and 6).

[Insert Table 2 about here]

The parameter estimates of the preferred fixed effects model indicate an inverse U-shaped relationship between the share of TAWs and establishment productivity. The significant coefficients of *temp* and *temp_2* in column 2 allow calculating a theoretical optimum, which corresponds to a TAW share of 13.63 %.[15] At this point, the performance effect of temporary agency work is strongest.

According to the results displayed in column 5, establishments with more than 30 % TAWs exhibit ceteris paribus a 19.4 % lower productivity than establishments without TAWs. This result is statistically significant at the 1 %-level. Establishments with less than 10 % TAWs exhibit a 0.2 % higher productivity than firms without TAWs. However, the estimated coefficient is not significantly different from zero, which can be explained as follows. The regression coefficient represents the marginal effects of a variable x on a variable y, if all other regressors take on their mean value and are held constant (ceteris paribus condition). Although a low share of TAWs per se would increase productivity, it is possible that establishments with a low share of TAWs in our sample are not more productive than those with a high share of TAWs, because regressors with a negative coefficient exhibit a high

[15] This figure, however, can just be considered as an approximation because of the standard errors of the estimated coefficients.

value for those establishments covered by the dummy *temp2*. Such regressors could mitigate the per se positive effect of temporary agency work. The consequence would then be an insignificant coefficient for the establishment dummy *temp2*. Apart from this point, both the pooled OLS and the random effects panel estimates (columns 4 and 6) show a positive performance effect of such establishments with a less than 10 % TAW share.

In the literature review we argue that a too large share of TAWs could have adverse effects on the motivation of both TAWs and regular employees. Therefore, in another specification we attempt to explain motivational problems with the extent of TAWs usage in client firms. The results are displayed in Table 3. Since these estimates result from the tobit maximum likelihood estimation method, we are not able to obtain unbiased fixed effects estimates (Ichniowski, Shaw and Prennushi 1997, footnote 15).

[Insert Table 3 about here]

There are no qualitative differences between the pooled OLS and the random effects panel estimates. The expected motivational problems (*mot*) increase significantly with the share of TAWs. This effect does not diminish, when the TAW share rises. This result is in line with our reasoning with respect to an inverse U-shaped relationship between TAWs and firm performance. According to Table 3, a low share of TAWs provides both regular and temporary employees enough incentives to increase their effort and thus firm performance. Apart from that, Ellingson, Gruys and Sackett (1998) show that initial motivation problems do not necessarily need to be associated with lower firm performance. However, as the share of TAWs rises, the incentive effect appears to become weaker. On the other hand, the negative motivation effect remains constant. All in all, this leads to a negative performance of those establishments experiencing a high share of TAWs.

4.3 Flexibility vs. Screening Strategy

4.3.1 Econometric Model

In order to detect potential productivity differences between establishments following the flexibility strategy or the screening strategy, respectively, we augment the Cobb-Douglas

production function by dummy variables indicating whether an establishment uses temporary agency work as a flexibility device (*flex*) or as a screening device (*screen*) or whether it follows a dual strategy (*fl_sc*). The estimation equation is:

$$\ln Y_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \gamma_1 flex_i + \gamma_2 screen_i + \gamma_3 fl\_sc_i + \sum_{j=1}^{n} \delta_j X_{ij} + u_i . \quad (5)$$

Since these indicator variables are only available in one year (2004), we can neither apply the pure fixed effects nor the pure random effects model on the whole set of explanatory variables to address the issue of unobserved firm heterogeneity. An appropriate solution in this case has been proposed by Black and Lynch (2001). Their two-step-procedure allows us to control for unobserved heterogeneity in a situation, where the core explanatory variables are only available in one panel wave. The first step consists of a within-estimation of a Cobb-Douglas production function, which is augmented by year, industry and regional dummies (summarized by the vector *Z*) to control for cyclical, sector-specific, and regional developments. Of course, the variables used in this first step estimation need to be available in more than just one year (here: 2000-2005):

$$\ln Y_{it} = \beta_0 + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{j=1}^{m} \eta_j Z_{itj} + v_i + u_{it} . \quad (6)$$

From the estimation of equation (6), the establishment fixed effect can be retrieved (Verbeek 2004):

$$\hat{v}_i = \overline{\ln Y_i} - \hat{\beta}_{1FE} \overline{\ln K_i} - \hat{\beta}_{2FE} \overline{\ln L_i} - \sum_{j=1}^{m} \hat{\eta}_j \overline{Z_{ij}} , \quad (7)$$

where the bars over the variables represent the corresponding mean values.

In the second step, this fixed effect is regressed on the strategy indicator variables (*flex*, *screen*, and *fl_sc*) and a set of control variables *X*:

$$\hat{v}_i = \gamma_0 + \gamma_1 flex_i + \gamma_2 screen_i + \gamma_3 fl\_sc_i + \sum_{j=1}^{n} \delta_j X_{ij} + \zeta_i , \quad (8)$$

where ζ_i is an i. i. d. random variable. The estimated coefficients $\hat{\gamma}_1, \hat{\gamma}_2, \hat{\gamma}_3$ are of special interest, because they represent the particular effect of the indicator variables – i.e. (*flex*, *screen*, and *fl_sc*) – on the fixed effect of an establishment's productivity.

4.3.2 Empirical Results

In analogy to the proceeding in Zwick (2006), Table 4 displays the estimates of the second stage of the Black-Lynch estimation procedure.[16] As a reference, Table 4 does also contain the usual cross sectional estimations applying the OLS method.

[Insert Table 4 about here]

Regarding the OLS estimates, flexibility establishments exhibit a significantly lower level of performance than the firms in the reference category (establishments, which do not follow any specific strategy concerning temporary agency work). On the other hand, the Black-Lynch estimates of the second stage uncover a higher performance level of screening establishments. The key point, however, is the question, whether or not the difference between the coefficients of the two strategy dummies is significant in each of the estimation equations. This can easily be tested for by a simple F-test. In both cases, the coefficients are significantly different with $p < 0.0025$. Hence, based on our estimates we can conclude that firms following the screening strategy are very likely to perform much better than firms following the flexibility strategy.

5. Conclusion

From our findings several conclusions can be drawn: First, the observation that more and more firms have begun to use temporary agency work can be explained by a positive productivity effect of temporary agency work, provided the share of temporary agency workers (TAWs) is relatively low. Second, the inverse U-shaped relationship between temporary agency work and firm performance can be explained as follows: If the share of TAWs in a firm is relatively low, the motivating effect on TAWs appears to dominate the threatening effect on permanent employees, so the net performance effect is positive. If,

[16] The results of the first step are available from the authors upon request.

however, the share of TAWs increases, the threatening effect begins to dominate the motivating effect, leading to a negative net performance effect. Third, firms using TAWs as a measure of screening are significantly more productive than firms using TAWs as a measure of flexibility. This could be explained by the fact that screening establishments offer the possibility of a long-term perspective to their TAWs, without threatening the secure positions of their permanent employees. Hence, we conclude that temporary agency work, handled appropriately, can indeed be considered as an effective and productivity enhancing screening device.

In our opinion, the present contribution adds to the existing literature in the following way. First, in contrast to former empirical studies, we are able to analyze panel data and can thus control for unobserved firm heterogeneity. Our results are robust to different specifications and estimation methods. Second, we are able to discriminate between different motives that firms may be following with the employment of TAWs. Specifically, we can discriminate between firms following the flexibility strategy and firms following the screening strategy. Thereby, we find that screening firms are better off than flexibility firms, which has also not been investigated yet.

The results of our study imply important recommendations for firms using the services of temporary work agencies by employing TAWs. First, the magnitude of employing TAWs should not exceed an amount of about 10 to 15 % relative to total employment. Second, our empirical results suggest following the screening strategy rather than the flexibility strategy. Although the screening strategy is not unlikely to involve a threatening scenario for permanent workers, the incentive effect for TAWs participating at the up or out-tournament obviously dominates the threatening effect. Analogously, the benefits of the flexibility strategy, e.g., rapid adjustments to demand fluctuation and cost reductions, appear to be outperformed by the drawbacks, which are associated with this strategy, namely the motivational problems caused by the formation of a dual labor market within a firm. In either case, we would advise firms employing TAWs to follow a screening strategy rather than a flexibility strategy. Contrary to the latter, the screening strategy announces the TAWs concerned the possibility of a long-term perspective within the firm and thus avoids the negative consequences of internally formed dual labor markets.

In the management literature some practical implementation proposals with respect to a responsible dealing with TAWs have already been made:[17] First, applying the concept of procedural justice, the TAWs commitment towards the firm is likely to increase, if they feel to be treated fairly relative to permanent employees (Camerman 2007). Second, the TAWs' general well-being and job satisfaction can be increased by expanding an existing empowerment concept from the level of permanent workers to the level of TAWs (Twiname, Humphries and Kearins 2006). For example, TAWs are likely to feel more assimilated, if the client firm incorporates them into its procedures, norms and values right at the beginning of the assignment (Slattery, Selvarajan and Anderson 2006). Moreover, if more decentralization and participation do not only apply for permanent workers but also for TAWs, job satisfaction of both types of employees is likely to be positively influenced, which in turn could be associated with a rise in firm performance. Analogously, if firms adopt a human resource management system that does not only focus on permanent employees but pays also sufficient attention to TAWs, firm performance is likely to increase. Potential components of such a HRM system may concern worker selection, training, performance evaluations, and fringe benefits (Koene and van Riemsdijk 2005; Mitlacher 2005). Of course, the productivity effects intended with such HRM systems are more likely to achieve, when the firm additionally follows a screening strategy than a flexibility strategy. Hence, the HRM measures described above and the screening strategy should be considered as complements.

These implementation proposals have the potential to prevent TAWs from being stigmatized (Boyce, Ryan and Imus 2007). Additionally, the implementation of such a coherent HRM system including the screening strategy is likely to constitute a win-win-situation for both parties. On the one hand, the client firms can benefit, because such a system is likely to increase their performance. On the other hand, also the TAWs can benefit, because they get the chance to improve their everyday life and their long-term job perspectives.

[17] A comprehensive analysis, comparison, and discussion of these proposals would certainly go beyond the scope of such a concluding section.

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Table 1: Descriptive statistics of key variables

Variable	Obs	Mean	Std. Dev.	Min	Max
mot	74107	0.3145992	0.6325092	0	4
lnY	78910	14.7836	2.407127	0	27.52457
temp	63284	0.7351526	3.795116	0	92.30769
temp1	63397	0.8897424	0.313213	0	1
temp2	63397	0.0888686	0.2845562	0	1
temp3	63397	0.0177611	0.132083	0	1
temp4	63397	0.0036279	0.0601234	0	1
flex	1810	0.1878453	0.3906965	0	1
screen	1810	0.1552486	0.3622416	0	1
fl_sc	1810	0.0475138	0.212794	0	1

Legend: Obs = observations
Source: IAB Establishment Panel 2000-2005

Table 2: Productivity effects of TAW employment (Panel 2002-2005)

Dependent variable: lnY **Estimation method: OLS Panel (pooled, fixed effects, random effects)**						
	C1 (pooled)	**C2 (FE)**	**C3 (RE)**	**C4 (pooled)**	**C5 (FE)**	**C6 (RE)**
lnK	.034 ***	.005 ***	.010 ***	.034 ***	.005 ***	.010 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnL	.913 ***	.405 ***	.930 ***	.906 ***	.407 ***	.929 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
temp	.012 ***	.003 *	.001			
	(0.000)	(0.060)	(0.588)			
temp _2 *100	-.031 ***	-.011 **	-.018 ***			
	(0.000)	(0.018)	(0.000)			
temp2				.159 ***	.002	.020 **
				(0.000)	(0.768)	(0.014)
temp3				.109 ***	.020	-.025
				(0.000)	(0.247)	(0.128)
temp4				-.212 ***	-.194 ***	-.417 ***
				(0.027)	(0.000)	(0.000)
qual	.004 ***	.001	.002 ***	.004 ***	.001	.002 ***
	(0.000)	(0.162)	(0.000)	(0.000)	(0.161)	(0.000)
orga1_std	.017 ***	.004	.007 **	.016 ***	.003	.007 **
	(0.002)	(0.235)	(0.013)	(0.004)	(0.252)	(0.014)
tech_std	.066 ***	.010 **	.025 ***	.066 ***	.010 **	.025 ***
	(0.000)	(0.013)	(0.000)	(0.000)	(0.015)	(0.000)
ikt	.046 ***	-.003	.015 **	.046 ***	-.003	.016 **
	(0.000)	(0.579)	(0.018)	(0.000)	(0.616)	(0.015)
wageset	.066 ***	.021 **	.048 ***	.066 ***	.021 **	.048 ***
	(0.000)	(0.021)	(0.000)	(0.000)	(0.020)	(0.000)
council	.252 ***	.021	.251 ***	.242 ***	.021	.251 ***
	(0.000)	(0.306)	(0.000)	(0.000)	(0.305)	(0.000)
noninc	-.141 ***	-.044	-.196 ***	-.152 ***	-.043	-.197 ***
	(0.000)	(0.315)	(0.000)	(0.000)	(0.327)	(0.000)
inc	.125 ***	-.015	.045	.117 ***	-.016	.043
	(0.000)	(0.703)	(0.103)	(0.000)	(0.701)	(0.118)
old	.058 ***	.011	.019 *	.058 ***	.0117	.018 *
	(0.000)	(0.402)	(0.067)	(0.000)	(0.410)	(0.073)
foreign	.279 ***	.016	.170 ***	.270 ***	.016	.169 ***
	(0.000)	(0.534)	(0.000)	(0.000)	(0.532)	(0.000)
export	.004 ***	.000	.002 ***	.004 ***	.001	.002 ***
	(0.000)	(0.753)	(0.000)	(0.000)	(0.757)	(0.000)
15 regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
8 sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
yr03	.023 *	.015 ***	.024 ***	.022	.015 ***	.024 ***
	(0.098)	(0.004)	(0.000)	(0.107)	(0.005)	(0.000)
yr04	.046 ***	.031 ***	.049 ***	.045 ***	.031 ***	.048 ***
	(0.002)	(0.000)	(0.000)	(0.002)	0.000)	(0.000)
yr05	.058 ***	.041 ***	.064 ***	.056 ***	.041 ***	.064 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
_cons	11.024 ***	13.553 ***	11.347 ***	11.044 ***	13.564 ***	11.350 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.8761	0.7730	0.8719	0.8764	0.7555	0.8720
N	24799	24799	24799	24799	24799	24799
n		11849	11849		11849	11849
N / n		2.1	2.1		2.1	2.1
Legend:	Coefficient (p-value)	*/**/*** indicates significance at the 10/5/1%-level				

Table 3: Motivational effects of TAW employment (Panel 2002, 2004-2005)

Dependent variable: mot **Estimation method: Tobit MLE Panel (pooled, random effects)**	**C1** **(pooled)**	**C2** **(RE)**	**C3** **(pooled)**	**C4** **(RE)**
lnK	-.002	-.001	-.002	-.001
	(0.501)	(0.160)	(0.507)	(0.160)
lnL	.354 ***	.086 ***	.353 ***	.086 ***
	(0.000)	(0.000)	(0.000)	(0.000)
temp	.024 ***	.004 *		
	(0.008)	(0.072)		
temp _2 *100	-.034	-.004		
	(0.172)	(0.497)		
temp2			.044	.021
			(0.439)	(0.135)
temp3			.310 ***	.057 **
			(0.004)	(0.034)
temp4			.416	.112 *
			(0.116)	(0.099)
qual	-.005 ***	-.001 ***	-.005 ***	-.001 ***
	(0.000)	(0.000)	(0.000)	(0.000)
orga1_std	.046 ***	.010 ***	.045 ***	.010 ***
	(0.005)	(0.005)	(0.005)	(0.005)
tech_std	-.080 ***	-.014 ***	-.080 ***	-.014 ***
	(0.000)	(0.002)	(0.000)	(0.002)
ikt	.223 ***	.019 *	.223 ***	.019 *
	(0.000)	(0.052)	(0.000)	(0.052)
wageset	-.041	-.007	-.041	-.007
	(0.346)	(0.479)	(0.339)	(0.469)
council	-.216 ***	-.049 ***	-.215 ***	-.049 ***
	(0.000)	(0.001)	(0.000)	(0.001)
noninc	.044	.016	.045	.015
	(0.564)	(0.441)	(0.560)	(0.466)
inc	.149 **	.047 **	.151 **	.047 **
	(0.027)	(0.016)	(0.025)	(0.017)
old	-.115 ***	-.025 **	-.115 ***	-.025 **
	(0.009)	(0.028)	(0.009)	(0.028)
foreign	.058	.014	.062	.014
	(0.452)	(0.533)	(0.424)	(0.544)
export	-.003 ***	-.001 **	-.003 ***	-.001 **
	(0.004)	(0.019)	(0.004)	(0.016)
15 regional dummies	Yes	Yes	Yes	Yes
8 sector dummies	Yes	Yes	Yes	Yes
yr04	-.196 ***	-.068 ***	-.194 ***	-.068 ***
	(0.000)	(0.000)	(0.000)	(0.000)
yr05	-.248 ***	-.074 ***	-.247 ***	-.074 ***
	(0.000)	(0.000)	(0.000)	(0.000)
_cons	-2.325 ***	.100 **	-2.327 ***	.101 **
	(0.000)	(0.017)	(0.000)	(0.017)
(Pseudo) R^2	0.0516	/	0.0516	/
Log Likelihood	-13240.346	-13402.284	-13240.578	-13401.634
N	17349	17349	17349	17349
n		10151		10151
N / n		1.7		1.7
Legend:	Coefficient (p-value)	*/**/*** indicates significance at the 10/5/1%-level		

Table 4: Flexibility vs. Screening Strategy

Dependent variables: lnY, lnY(FE) Estimation methods: OLS, Black-Lynch	C1 (Cross section)	C2 (Black-Lynch)
lnK	.011	
	(0.187)	
lnL	1.020 ***	
	(0.000)	
flex	-.184 ***	-.096
	(0.002)	(0.244)
screen	.032	.261 ***
	(0.611)	(0.010)
fl_sc	.167	.195
	(0.140)	(0.268)
qual	.004 ***	.003 **
	(0.000)	(0.020)
orga1_std	.058 **	.082 **
	(0.046)	(0.025)
orga2_std	-.032	.073 **
	(0.113)	(0.021)
incentive	.171 ***	.378 ***
	(0.001)	(0.000)
tech_std	.084 ***	.141 ***
	(0.001)	(0.000)
ikt	.068	.200 **
	(0.345)	(0.034)
inno_std	-.014	.007
	(0.541)	(0.815)
wageset	.056	.269 ***
	(0.331)	(0.001)
council	.196 ***	.950 ***
	(0.009)	(0.000)
noninc	-.396 **	-.539 **
	(0.019)	(0.017)
inc	-.079	-.027
	(0.598)	(0.885)
old	.046	.504 ***
	(0.497)	(0.000)
foreign	.133 **	.076
	(0.045)	(0.432)
export	.001	.007 ***
	(0.132)	(0.000)
training	-.093	.213 *
	(0.293)	(0.075)
15 regional dummies	Yes	No
8 sector dummies	Yes	No
_cons	11.517 ***	-.613 **
	(0.000)	(0.023)
R^2	0.8627	0.4602
N	858	858
Legend:	Coefficient (p-value)	*/**/*** indicates significance at the 10/5/1%-level

Appendix

Table 5: Description of all variables used

Variable name	Variable description
mot	Motivation Problems
lnY	Log Output
temp	Share of temporary agency workers (TAWs) relative to total employment
temp_2	Share of temporary agency workers, squared
temp1	Establishment with 0% TAW
temp2	Establishment with 1-10% TAW
temp3	Establishment with 11-30% TAW
temp4	Establishment with >30% TAW
flex	Flexibility dummy
screen	Screening dummy
fl_sc	Interaction term (flex x screen)
lnK	Log capital stock
lnL	Log total employment
qual	Share of high-skilled workers relative to regular employment
orga1_std	Insourcing/Outsourcing, standardized
orga2_std	Holistic reorganization of working environment, standardized
incentive	Pay for performance (profit sharing, stock ownership program)
tech_std	State of technical machinery, standardized
ikt	Investments in information and communication technology
inno_std	Product innovations, standardized
wageset	Collective wage agreement
council	Work council
noninc	Non-incorporated firm
inc	Incorporated firm
old	Founded before 1990
foreign	Held by foreigners
export	Share of export relative to total sales
training	Offered training for employees
reg1	Berlin
reg2	Schleswig-Holstein
reg3	Hamburg
reg4	Lower Saxony
reg5	Bremen
reg6	North Rhine-Westphalia
reg7	Hesse
reg8	Rhineland-Palatinate
reg9	Baden-Württemberg
reg10	Bavaria
reg11	Saarland
reg12	Brandenburg
reg13	Mecklenburg-Western Pomerania
reg14	Saxony
reg15	Saxony-Anhalt
reg16	Thuringia
sector1	Agriculture/Forestry; mining/energy/water
sector2	Manufacturing
sector3	Construction
sector4	Trading und repairing

sector5	Transportation/communications/news
sector6	Financial services (banks, insurance companies)
sector7	Services for firms
sector8	Other services
sector9	Public sector
yr00	Dummy for 2000
yr01	Dummy for 2001
yr02	Dummy for 2002
yr03	Dummy for 2003
yr04	Dummy for 2004
yr05	Dummy for 2005

Table 6: Descriptive statistics of all variables used

Variable	Obs	Mean	Std. Dev.	Min	Max
mot	74107	0.3145992	0.6325092	0	4
lnY	78910	14.7836	2.407127	0	27.52457
temp	63284	0.7351526	3.795116	0	92.30769
temp1	63397	0.8897424	0.313213	0	1
temp2	63397	0.0888686	0.2845562	0	1
temp3	63397	0.0177611	0.132083	0	1
temp4	63397	0.0036279	0.0601234	0	1
flex	1810	0.1878453	0.3906965	0	1
screen	1810	0.1552486	0.3622416	0	1
fl_sc	1810	0.0475138	0.212794	0	1
lnK	92409	7.550145	6.023915	0	23.12543
lnL	93108	3.275965	1.926965	0	10.83671
qual	93733	64.36131	29.44357	0	100
orga1_std	93285	-8.21E-10	0.9999732	-0.2837251	12.65308
orga2_std	31561	-8.93E-09	0.9999841	-0.7938462	5.72914
incentive	47423	0.1150286	0.3190598	0	1
tech_std	93582	-9.42E-09	0.9999733	-3.582273	1.589948
ikt	50279	0.7669604	0.4227715	0	1
inno_std	31203	-2.43E-09	0.999984	-0.7619234	2.930587
wageset	93773	0.549028	0.4975931	0	1
council	100990	0.3630756	0.4808887	0	1
noninc	92724	0.3190652	0.4661169	0	1
inc	92724	0.4806954	0.4996299	0	1
old	81744	0.6321198	0.4822315	0	1
foreign	91673	0.0486948	0.2152304	0	1
export	92510	5.315079	15.79661	0	100
training	31862	0.6263888	0.4837698	0	1
sector1	141989	0.0258612	0.1587216	0	1
sector2	141989	0.1706822	0.3762324	0	1
sector3	141989	0.0606174	0.238628	0	1
sector4	141989	0.0893942	0.285313	0	1
sector5	141989	0.0246005	0.1549048	0	1
sector6	141989	0.0188184	0.1358836	0	1
sector7	141989	0.0754706	0.2641502	0	1
sector8	141989	0.133785	0.3404224	0	1
sector9	141989	0.0632021	0.2433269	0	1
reg1	141989	0.049694	0.2173127	0	1

reg2	141989	0.027474	0.1634605	0	1
reg3	141989	0.0226849	0.1488973	0	1
reg4	141989	0.0508772	0.2197477	0	1
reg5	141989	0.0416722	0.1998398	0	1
reg6	141989	0.0788653	0.2695293	0	1
reg7	141989	0.0433977	0.2037515	0	1
reg8	141989	0.0394256	0.194606	0	1
reg9	141989	0.0580256	0.2337927	0	1
reg10	141989	0.0566734	0.2312183	0	1
reg11	141989	0.030939	0.1731531	0	1
reg12	141989	0.0512152	0.2204372	0	1
reg13	141989	0.0512082	0.2204229	0	1
reg14	141989	0.0576031	0.2329921	0	1
reg15	141989	0.0527858	0.2236063	0	1
reg16	141989	0.0559832	0.2298901	0	1
yr00	141989	0.1399545	0.346941	0	1
yr01	141989	0.1626816	0.3690762	0	1
yr02	141989	0.179366	0.3836598	0	1
yr03	141989	0.172788	0.3780653	0	1
yr04	141989	0.171309	0.3767801	0	1
yr05	141989	0.1739008	0.3790255	0	1

Legend: Obs = observations
Source: IAB Establishment Panel 2000-2005