Productivity in German manufacturing firms: Does fixed-term employment matter?

Sebastian Nielen*and Alexander Schiersch†

Abstract

A growing proportion of employees are working under fixed-term contracts. This paper empirically analyzes whether this strategy actually improves firm productivity. To this end, a large data set of German manufacturing firms and various panel data models are used in order to reveal the expected non-linear effect. Thereby the analysis also takes into account distortions that may result from selection into the use of fixed-term employment. The results of the investigation show that there is no significant effect of fixed-term employment on labor productivity when taking into account potential selection effects.

Keywords: fixed-term employment, labor productivity, manufacturing
JEL-Codes: D24, L23, L60

*Institute for Applied Economic Research Tübingen, Ob dem Himmelreich 1, 72074 Tübingen, Germany, e-mail: sebastian.nielen@iaw.edu

†German Institute for Economic Research, Mohrenstrasse 58, 10117 Berlin, Germany, e-mail: aschiersch@diw.de

1 Introduction

The importance of fixed-term employment in Germany is constantly increasing. The share of fixed-term contracts for new hires increased from around 30 percent in 2000 to about 45 percent in 2010 (IAB, 2011). Although approximately 50 percent of all fixed-term contracts end with transfers into permanent contracts, the proportion of fixed-term workers in Germany is constantly increasing. In 2010 more than 9 percent of all employees required to contribute to social security in Germany are employed under a fixed-term contract. In 2000 this figure was only about 6 percent (Gundert & Hohendanner, 2011). The increasing importance of this type of employment raises the question of whether and how it affects firm performance.

Previous research on temporary work and fixed-term contracts identifies two principle reasons for using this instrument. Firstly, the instrument is used to increase the external flexibility of labor input. Hence, severance payments and the like are not necessary, since expiring contracts simply reduce the number of employees through attrition when demand declines. Second, fixed-term contracts can be used to screen for productive workers. Thus, by selecting the latter and offering them permanent contracts, the overall quality and productivity of the workforce should increase.

However, within the labor market and management literature, the disadvantages of temporary work are also revealed. Here, it is mainly the demotivating effect that temporary work can have on both, temporary and permanent workers, when this instrument is abused. Moreover, the firm specific human capital of temporary workers is lower than that of permanent workers and firms have little incentive to invest in the training of temporary workers.

Since there are opposing effects of temporary work, its overall effect on firm performance is unclear. Previous literature on this topic is rare. Using sector aggregates, Damiani and Pompei (2010) analyzes the effect of labor protection on Total Factor Productivity (TFP) growth in 18 European countries between 1995 and 2005. They also control for the effect of growth in temporary employment on TFP, finding a negative and significant relation. Also using sectoral data, Auer et al. (2005) analyze the effect of employment tenure on productivity in 13 European countries for the 1992 to 2002 period. Their results show that productivity increases with increasing job tenure, but decreases after thirteen years of job tenure. However, it follows for the case of fixed-term employees, that

firms with a lower share of fixed-term worker should have a higher productivity. Making use of Spanish sectoral data from 1987 to 2000 Ortega and Marchante (2010) report a negative effect of temporary contracts only in the manufacturing and energy sector. For the remaining sectors no effects are found.

At the micro level, Cappellari et al. (2012) use 13,000 firm level observations of all Italian sectors between 2004 and 2007 in order to analyze the effects of deregulation reforms of apprenticeship and fixed-term contract. They find a small negative, but only weakly significant, effect of the reforms of fixed-term employment on labor productivity and must, therefore, reject their hypothesis that reforms in the legislation of fixed-term increase labor productivity. However, this result is in line with the findings of the two previously mentioned studies. Finally, Kleinknecht et al. (2006) analyze the effect of fixed-term employment using 590 Dutch firm observations. They find no significant effect of the percentage of personnel on fixed-term contracts on sales growth. In order to check the robustness of this finding, they also split the dataset into firms with active R&D and firms without active R&D. Again, in both subgroups no effect of the use of fixed-term employment on sales growth was found. Hence, previous empirical results point toward a weakly negative relationship with the exception of Kleinknecht et al. (2006).

This paper contributes to the literature by analyzing the effect of fixed-term employment on labor productivity for German manufacturing firms. In contrast to the aforementioned studies, we control for the inherent selection problem into using fixed-term contracts by means of the inverse Mills ratio, since some firms systematically do not use this instrument. Additionally, we apply dynamic panel data models to soften the assumption of strict exogeneity of explanatory variables.

The remainder of the paper is organized as follows. The subsequent section discusses related literature and derives the hypothesis. The data are introduced and first descriptive statistics are discussed in section three. The methods used in this study as well as the empirical strategy are introduced in section four along with the empirical analysis. Section five provides a concluding discussion.

2 Theoretical framework

In this section we present theoretical and empirical arguments to explain the relationship between the use of temporary employment and labor productivity.

Within the extensive labor market and management literature, we identify three main factors and how they affect labor productivity. The first one is temporary employment as a tool to adjust the employment to product demand fluctuations. The second one is the screening aspect of temporary employment and the last one argues via firm specific human capital. At the end of this section we discuss how the different aspects might jointly affect labor productivity and derive the hypothesis.

Temporary employment and demand fluctuations

In the case of demand fluctuation or a drop in demand, firms adjust all inputs accordingly. Yet, strict employment protection legislation (EPL) can "increase the cost of firing workers, thereby reducing the productivity threshold at which firms are willing to lay off worker" (Bassanini et al., 2009, p.358). Hence, one reason why firms use temporary employment is because doing so allows for adjusting labor input when demand fluctuates while avoiding termination costs. One theory in this respect was developed by Nunziata and Staffolani (2007). It suggests that an increase in the demand for more flexible forms of employment is driven by increasing redundancy costs and volatile product demands. This is in line with the model of Bentolila and Saint-Paul (1992), which suggests that the demand for temporary employment is driven by fluctuations in product demand.

These theoretical considerations are confirmed by the survey of Houseman (2001) on reasons for using temporary employment. In it, the adjustment on demand fluctuations is named as the most important reason for using temporary employment. In the empirical part of the study, Houseman (2001) find a significant relationship between industry seasonality and the probability for using temporary work. Empirical evidence for the adjustment argument is also found by Vidal and Tigges (2009). Moreover, using data of establishments in Germany, Hagen (2003) reports that using fixed-term contracts increases the adjustment speed of work force to changes in product demand. Because the greater flexibility offered by fixed-term contracts helps to address changes in product demand, temporary work should have a positive effect on labor productivity. However, the effect of this instrument is limited because the termination of fixed-term workers without paying redundancy costs is only possible when the contract ends.

Temporary employment and screening

Another important aspect of fixed-term contracts is the fact that it can be used to screen for new productive workers or to substitute for core workers. According to principal agent theory, firms cannot observe the productivity of potential new employees before hiring them. Wang and Weiss (1998) provide a theoretical model in which firms use fixed-term contracts to screen new employees for a certain period. After the screening period the more productive employees will get open-ended contracts. This is congruent to the argument put forward by Lagos (2006). He argues that "economies with relatively high unemployment benefits will tend to exhibit relatively high levels of TFP" (Lagos, 2006, 992). The reason is that if workers reservation wages increase, labor markets become tighter, "which in turn increases worker's outside option and raises measured TFP" (Lagos, 2006, 992). The Total Factor Productivity (TFP) is rising because firms are no longer willing to accept low productivity and therefore are willing to hire only best matches and highly productive employees. One tool to find most productive workers is to use temporary employment for screening.

Using fixed-term contracts to screen potential new employees increases productivity in two ways. First, during the probation period the employee has an incentive to increase his/her effort in order to be offered an open-ended contract. This is confirmed by the findings of Engellandt and Riphahn (2005). They find that employees with a fixed-term contract have a higher probability to work unpaid overtime compared to employees with open-ended contracts. Moreover, Ichino and Riphahn (2005) show that job security after a probation period increases incentives for absenteeism. In turn, an increased probation period via temporary contracts might also serve as an incentive to be more productive. This is in line with the theoretical findings of Dolado and Stucchi (2008). Within their model they show that workers effort increases when the probability of getting a permanent contract increases. This positively affects TFP. However, they also point to other aspects of a high share of temporary workers that are not covered by the model but might have a negative effect on productivity (Dolado & Stucchi, 2008). Second, offering open-ended contracts to only the most productive fixed-term contract employees will increase the productivity in the long run.

Empirical evidence for the screening argument is found by Gerfin et al. (2005) and Addison and Surfield (2009). Additionally results of Picchio (2008) show

that a fixed-term contract can help employees obtain an open ended contract later on. For Germany, empirical evidence for the screening argument is reported by Boockmann and Hagen (2008). Gash (2008) find empirical evidence for fixed-term contracts to be a bridge to an open-ended contract. Moreover, McGinnity et al. (2005) show that fixed-term contracts are often used as a tool to screen new employees during the transition from education to work in West Germany. Using data from the German Socio-Economic Panel, Mertens and McGinnity (2004) find, that about 40 percent of employees with a fixed-term contract have an open-ended contract one year later. Overall, empirical evidence for the use of temporary work as a sorting mechanism is given for Germany. However, in the case of Spain, where the labor market is highly segmented between temporary and permanent work, there is no evidence for the screening aspect of fixed-term employment (Amuedo-Dorantes, 2000). Thus, the effect also depends on the structure and permeability of the labor market.

As mentioned above, fixed-term employees can also be used to substitute core workforce. Yet, this strategy comes with negative effects since it could lead to decreased motivation of both, fixed-term and existing core employees (Vidal & Tigges, 2009). Decreasing motivation of employees with fixed-term contracts may result from lower job stability (Bergmann & Mertens, 2011), lower job satisfaction (Bryson, 2013) and lower wages (Mertens et al., 2007) compared to employees with permanent contracts. Lower motivation of core workers could be driven by decreasing trust in the commitment of the firm (George, 2003). Less motivation of both types of workers could then result in lower labor productivity (Brown & Sessions, 2005). This effect directly depends on the share of temporary workers on total work force of a firm. If the share of employees with fixed-term contracts is relatively high, employees fear a replacement strategy instead of screening and motivation may decrease (DeCuyper et al., 2008). Hence, with respect to screening and motivation, the effect of fixed-term workers on productivity depends on their share in total work force. On the one hand, a moderate use of fixed-term contracts should increase labor productivity due to the screening possibility and its positive motivational aspects. On the other hand, excessive use could negatively affect labor productivity because motivation of both types of workers decreases.

Temporary employment and human capital

A third aspect of fixed-term contracts is the positive link between productivity and firm specific human capital. Theory suggests that investments in firm specific human capital depend on labor market conditions. In an extension of his model on labor markets with search friction and firing costs, Wasmer (2006) analysis the incentives of firms to invest in human capital. Referring to Becker Becker (1964), he implies that firms are willing to partly or fully subsidies training costs. In a perfectly free labor market firms do not gain. Yet, in a labor market with low turnover rates due strong EPL (e.g. high firing costs), as for instance the German labor market, "firms gain from fostering specific skills acquisition by gaining more productivity" (Wasmer, 2006, 821). However, investing in firm specific human capital becomes profitable in the long run. Hence, if the contract of employees ends after a relative short period, there is little incentive for firms to invest in the firm specific human capital of these employees. Therefore an increasing share of fixed-term contracts on total work force should go in line with decreasing investments in firm specific human capital.

Empirical evidence for a negative relationship between temporary work and investing in human capital is reported by Arulampalam et al. (2004). Also Booth et al. (2002) find that employees with temporary jobs receive less training than employees with open-ended contracts. Moreover, findings of Shire et al. (2009) suggest that firms offering further training tend to make use of long term contracts instead of temporary employment. The same is reported by Albert et al. (2005). They find that firms that do not provide vocational training have higher shares of temporary worker compared to firms offering further training. Their results also show that given that a firm provides on the job training, employees with temporary contracts have a lower probability of receiving training compared to the ones with open-ended contracts. Yet, as shown by Zwick (2006) for the German case, on-the-job training enhances firm productivity. Moreover, employees receiving training are also more satisfied with their job and, therefore, have a higher job performance (Jones et al., 2009). Regarding the relationship of fixed-term employment and the incentive to invest in human capital, an increasing share of employees with temporary contracts reduces labor productivity due to lower investments in firm specific human capital.

Temporary employment and labor productivity

Summing up, we find arguments for a positive as well as for a negative relationship between the share of fixed-term workers in an establishment and its productivity. First, regarding flexibility, using temporary employment should increase labor productivity via increasing flexibility in case of product demand changes. However, positive effects resulting from an increased flexibility are restricted because employees with a fixed-term contract can only be laid off without paying redundancy costs when the contract expires. Second, a moderate use of fixed-term employment to screen for productive employees should increase labor productivity. An extensive use in order to replace core workers with temporary ones may reduce labor productivity due to the decreased motivation of both types of employees. Third, an increasing share of fixed-term employees should be accompanied with decreasing labor productivity because the incentive to invest in firm specific human capital is lower compared to permanent employees as human capital and productivity are positively linked. Combining these arguments, the overall effect of the share of fixed-term employees on labor productivity depends on the share of fixed-term contracts on total work force of an establishment. Table 1 compares the expected effects of fixed-term employment on labor productivity for low and high shares.

[insert Table 1 about here]

The expected effect of fixed-term employment on labor productivity depends on the intensity temporary employment is used: a moderate use of fixed-term contracts should increase labor productivity due to increasing flexibility of labor input and the possibility to screen for productive employees, both overcoming the negative effect of lower firm specific human capital; an intensive use should have a negative effect on labor productivity because both types of employees are less motivated and fixed-term contract employees tend to have lower human capital, both overcompensating the positive effect of a higher flexibility of labor input. With an increasing share of fixed-term employees in total workforce, the positive effects on productivity became less effective and negative effects became more effective. At some point positive and negative effects cancel each other out. When increasing the share of fixed-term employees above this threshold, the negative effects exceed positive effects. Hence, our hypothesis is that the relationship between the intensity of using fixed-term workers and labor productivity is inverse

U-shaped.[1]

3 Data

Sample

The study uses IAB Establishment Panel data for the 2004 to 2009 period. The data are gathered and compiled by the German Federal Employment Agency (*Bundesagentur für Arbeit*). It is an annual survey covering about 15500 establishments per year, designed to be representative both for average and for longitudinal analysis (Fischer et al., 2009). The questionnaire includes questions about staff development, personnel requirements, sales, investment, exports, as well as R&D, innovation and organizational change (Bellmann et al., 2002). In addition, there are specific questions addressing the different forms of employment used by the firm, such as temporary agency work or fixed-term employment. Altogether, the dataset contains about 320 variables, which, however, are mostly related to labor market issues.[2]

In order to create a panel, the IAB provides a STATA and SPSS syntax that has to be applied on the data to combine the waves.[3] In these programs some variables are treated to ensure comparability over time since the questionnaire has changed slightly over time. We refrain from discussing every code line here as the interested reader can find each individual step in the syntax and the detailed description of every variable for each year in Städele and Müller (2006). After the recoding and renaming has taken place, the waves are merged into a single dataset creating a panel. In this step, the procedure of the IAB also includes the transformation of values between two years. This takes place for organizational variables that refer to changes in past years.[4]

[1] The hypothesis of an inverse U-shaped relationship between temporary employment and firm performance is in line with the one formulated by Nielen and Schiersch (in press) and Hirsch and Mueller (2012) for the case of temporary agency work.

[2] The questionnaire can be downloaded for each year. See http://fdz.iab.de/en/FDZ_Establishment_Data/IAB_Establishment_Panel/IAB_Establishment_Panel_Working_Tools.aspx. Moreover, Städele and Müller (2006) provide a detailed description for each variable up to 2005.

[3] http://fdz.iab.de/en/FDZ_Establishment_Data/IAB_Establishment_Panel/IAB_Establishment_Panel_Working_Tools.aspx

[4] This is done for the variables *responsibilities, team work, reliance on internal labour,*

However, one significant challenge, unresolved by the IAB procedure, remains. Within each survey, questions focus on different time horizons. More specifically, the questions on turnover, foreign sales, sources of founding, sum of investments etc. refer to the previous year. The questions on the business development in the next year, plans to change the number of employees, plans to produce abroad , to invest in EU countries etc. refer to the next year. Moreover, a number of the questions, mainly on inputs, for example on the number of employees liable to social security, the number of skilled workers, the number of unskilled workers, the number of temporary employees and of fixed term employees etc. refer to June 30th of the year that the survey took place.[5] Hence, even after the IAB procedure, data for an establishment in specific year refer to different years. This means, for example, that the data assigned to year/wave 2001 contain the turnover for the year 2000, the number of employees refers to the year 2001 and the investment plans refer to 2002. Hence, during data preparation, we must ensure that data are correctly assigned to the year that they reflect.

In order to resolve the time dimension problem, we adapt the IAB procedure and transfer establishment data of wave t+1, which refer to the situation in t, to the very same establishments in wave t. This is possible because each establishment has a unique ID, which ensures that the data for each establishment in a year belongs to that very year. However, this also means that we lose 2009 from the analysis, since some of the data collected in 2009 belongs to 2008; for example turnover, which is transferred to 2008.[6] Thus, the dataset covers the period 2004 to 2008. Furthermore, we only include firms with at least five employees. The reason for this is the German Employment Protection Act, a law that applies only to firms with fewer than 5 employees. Below that threshold, firms can rather easily hire and fire people. Hence, in these firms there is no need for fixed-term employment to increase flexibility or even screen newly hired

Expansion of purchase of products, Restructuring of procurement, Restructuring of departments, Ecological measures in enterprise, Improvement of quality management, etc. For more details and every variable see the syntax in the STATA file 5̈_Transfer_of_values.doävailable at http://fdz.iab.de/en/FDZ_Establishment_Data/IAB_Establishment_Panel/IAB_Establishment_Panel_Working_Tools.aspx

[5]The questionnaires for each year can be downloaded at http://fdz.iab.de/en/FDZ _Establishment_Data/IAB_Establishment_Panel/IAB_Establishment_Panel_Working_Tools.aspx

[6]However, even if we would forgo this step and work with lagged independent variables, 2009 would be lost since we would need the data of wave 2010, since the output of 2009 is captured in the wave 2010.

workers.[7] Including firms with less than 5 employees will, therefore, bias the analysis. Since this study focuses on manufacturing establishments, all non-manufacturing establishments are excluded. Finally, all firms with fewer than three observations are excluded in the latter analysis in order to apply panel data models. The final sample consists of 8787 observations from 2244 manufacturing establishments.

Measurement of variables

The dependent variable in the analysis is the log of labor productivity (*Labor-Prod*), which is calculated as real sales per capita. The deflation is done using sectoral producer price indices of the OECD for Germany. The regressor of interest is the log of the share of fixed-term employed on total employees (*Share*). Here, neither the number of temporary agency workers nor interns are taken into account. The reason is that both numbers are asked for as date data. We know, however, that the job duration of fifty percent of all temporary agency workers in client firms is less than 3 month. Interns in Germany work between one and six months. Hence, although we might find temporary agency workers or interns on the 30th of June, it is highly possible that they have not been in the firms in the beginning of a year and that they will not be there through the end of a year. Simply adding them to the number of employees would therefore cause the analysis to be biased.[8] For the so-constructed variable, we expect the coefficients of *Share* to be significantly positive if the theoretical remarks of section two hold true. Moreover, since the effect might be non-linear, the variable is also included in the analysis with its squared values (*Share2*) and the respective coefficient is expected to be negative.

In addition to these regressors, we include the logarithms of the following control variables: the overall number of employees to capture the size of the firms (*Size*); the proportion of intermediate inputs on sales (*Intermediate*) to capture the position of the firms in the value chain; the share of qualified employees on total labor force (*Qualified*) to catch the human capital intensity of production;

[7] As part of the 2004 Hartz IV reforms, the threshold increased to 10 employees. However, the transitional rules imply that for companies with more than 5 "old" workers, the former limit of 5 employees still applies. Hence, we kept the limit of 5 employees.

[8] We estimate models including the share of temporary agency workers as control variable. Our results are not affected by this robustness check. The respective results are available upon request from the authors.

the share of part time worker in the company (*Part time*) as an additional control variable for the employment structure; the share of exports on sales (*Export*) to take into account the range of business activities of firms; and finally the investments per capita (*Investment*), which captures investments in ICT capital, production equipment, buildings and the like, as proxy for the capital intensity of production.

Additional control variables in the analysis are the following dummy variables: the age of the companies (*Age1-Age5*) for companies younger than five years, five to nine years, ten to fourteen years, fifteen to nineteen years, and twenty or more years; a dummy variable that equals one if a company closed a part of the firm within the last year (*Closed*); a dummy variable if a part of the firm was outsourced (*Outsourced*); if a spin-off has taken place (*Spin*); a dummy variable that becomes one if a part of another company was integrated (*Integrated*); dummy variables if the majority owner is East German (*Owned1*), West German (*Owned2*), a foreigner (*Owned3*), is the state (*Owned4*), has no majority owner (*Owned5*) or if the majority owner is unknown (*Owned6*); dummy variables for each of the sixteen industries in the analysis; as well as sixteen dummy variables for federal states the establishments are located in; dummy variables for companies with sectoral collective agreement, company collective agreement and no collective agreement (*Tarif1-Tarif3*); and a dummy variable taking the value of one if a company has a work council (*WorkConcil*).

[insert Table 2 and Table 3 about here]

Table 2 provides descriptive statistics for all continuous explanatory variables and for the dependent variable labor productivity, distinguishing between within and between variation and Table 3 contains simple descriptive statistics for the dummy variables. For most variables between variation exceeds within variation. Interestingly for *Share* the between variation is only a little higher. Hence, the share of fixed-term employees changes considerably over time and not just between establishments.

[insert Table 4 and Table 5 about here]

Table 4 reveals the regional distribution of observations and Table 4 contains the descriptive statistics of the share of fixed-term employment per industry. From Table 4 it can be seen that 4377 establishments are located in West Germany, while 4126 are located in East Germany and Berlin is the location of 284

establishments. The mean share is rather low, ranging from 2 to 5 percent in the entire data set. But among those firms that used fixed-term employment, the mean ranges from 5.2 to 13 percent. Moreover, the maximum share ranges from 26 to almost 100 percent. Thus, fixed-term employment is a significant input factor and is occasionally heavily used. Finally, since some firms have never used this instrument, the analysis is subject to a selection problem.

4 Empirical investigation

The analysis of the relationship between the use of fixed-term contracts and labor productivity is presented in three steps. First is our estimation strategy. We follow with our main results, and then, some robustness checks are presented.

Methods and empirical strategy

To control for the potential self-selection into the use of fixed-term contracts, the empirical estimation starts with the estimation of a probit selection model. The dependent variable takes the value of one if a company uses fixed-term contracts and zero otherwise. Based on the result of the probit model we calculate the inverse Mills ratio. This ratio is used as an additional variable in the regression models to control for the selection effect. For detailed discussion of this approach see Briggs (2004). To increase identification of the model and to avoid potential multicollinearity between the inverse Mills ratio and the explanatory variables of the regression models we make use of exclusion restriction as proposed by Puhani (2000). This means, we exclude some variables used in the selection model from the regression models in the second stage.

For the exclusion restriction we use dummy variables for the varying types of collective agreement. The data distinguishes between three different types of collective agreement: industrial collective agreement, company agreement and no collective agreement. We argue that establishments have different probabilities of using fixed-term employment depending upon whether they have collective agreements or not. Establishments with industrial collective agreements are expected to be more likely to use temporary contracts, because fixed-term contracts can be used to avoid the strict employment regulations that result from collective agreements. In case of a company agreement, the use of fixed-term employment is often regulated by agreement. Hence, establishments with a company agreement

are expected to be less likely to use fixed-term employment because the agreement restricts the use of this kind of employment. In the first stage the dummy variables for company agreement and no collective agreement are included in the selection equation to estimate the probability of using fixed-term employment. The dummy for industrial collective agreement is the respective reference category.[9]

To test the hypothesis of an inverse U-shaped relationship between the use of fixed-term employment and labor productivity, the following equation is estimated:

$$log(LabProd_{it}) = \beta_1 Share_{it} + \beta_2 Share2_{it} + \gamma_k log(x_{kit}) + \theta_m D_{mit} + \delta Mills_{it} + v_i + u_{it}$$

with *i=1,...,N*, *t=1,...,T*, *Share=log(1+Share)* and *Share2=0.5*Share*^{2}. $Share_{it}$ is the quotient of employees with a fixed-term contract and total work force of an establishment. X_{kit} denotes all continuous control variables, D_{mit} indicates all dummy variables including year dummies and $Mills_{it}$ captures the self-selection into the use of fixed-term employment via inverse Mills ratio. Finally with v_i denotes an establishment specific fixed effect and u_{it} is the error term capturing unsystematic influences of labor productivity.

The estimation strategy is as follows: To get a first impression of how the use of fixed-term contracts and labor productivity are related, we start with estimating a simple OLS regression model. In order to exploit the panel structure of the data and to control for correlation between unobserved fixed effects and the explanatory variables, we then apply a fixed effect regression model. Finally we estimate two specifications of a system GMM model to account for dynamic effects and possible endogeneity of explanatory variables resulting from a correlation with past error terms.

To overcome the potential weak instrument problem of the first difference GMM estimator proposed by Arellano and Bond (1991), we apply the system GMM estimator implemented by Arellano and Bover (1995) and by Blundell and

[9] Additionally, we use two alternative exclusion restrictions and estimate one model without an exclusion restriction in order to check whether our results are affected by changes in the exclusion restriction. First, we use six different dummy variables for legal status and second, a combination of collective agreement and legal status dummies are used. Finally, we estimate the selection equation without an exclusion restriction. However, the results of our second stage regression models are not affected by changes in the exclusion restriction. The respective results are available upon request from the authors.

Bond (1998). All system GMM models are estimated by using the package provided by Roodman (2009a). Following Roodman (2009b), we reduce the number of instruments by using the collapse option. In the first specification all explanatory variables are treated to be exogenous. In the second specification, both share variables are treated as predetermined. Thus, they are assumed to be potentially correlated with past error terms but not with current ones. The lagged dependent variable is endogenous by the nature of the model and is therefore instrumented with own lags starting with lag order two. For all system GMM specifications p-values of the Hansen test of over-identifying restrictions and p-values of a test for second order autocorrelation of the error terms in differences are reported. We are aware of the fact that applying panel data models does not necessary allow for a causal interpretation of the results. This is the case even if the strong assumption of strict endogeneity of explanatory variables is relaxed by using system GMM models.

For a first robustness check the fixed effects model and both system GMM specifications are estimated without controlling for the inherent selection into the use of fixed-term contracts. To take into account differences between West and East Germany, we apply separate estimations for both groups. This estimations again cover the fixed effects model and both system GMM specifications.

Estimation results

The analysis starts by calculating the inverse Mills ratio to account for potential self-selection into the use of fixed-term contracts. The corresponding estimation results of the probit model are outlined in column one of Table 6. In accordance with Kleinknecht et al. (2006), we find a positive coefficient for firm size and a negative one for the share of qualified employees.

[insert Table 6 about here]

The actual analysis of the relationship between labor productivity and the share of fixed-term employees in total workforce starts with an OLS model in column two, followed by a fixed effects model in column three of Table 6. In both estimates, we find a positive but insignificant coefficient for the *Share* variable as well as a negative coefficient for the *Share2* variable. The coefficient for *Share2* is weakly significant only in the fixed effects model. Hence, the results

rather indicate the existence of a weakly negative relationship between labor productivity and the use of fixed-term employment than the existence of an inverse U-shaped relationship. Column 4 and 5 contain the estimates of the system GMM approaches. In column 4, all regressors are modeled as exogenous, except the lagged dependent variable, while in the second system GMM model both *Share* and *Share2* variables are assumed to be predetermined. We treat both *Share* and *Share2* variables this way in order to check whether previous results are affected by potential endogeneity resulting from a correlation between the share variables and past error terms. In both estimates, however, we find negative, but insignificant coefficients for *Share* and *Share2*. This implies, first, that the imposed inverse U-shaped relationship is rejected by both estimations and, second, that the potentially negative but weak relationship, as found in the fixed effect model, finds only weak support. In general, the results of our basic models do not support the hypothesis of an inverse U-shaped relationship between the share of fixed-term employees on total work force and labor productivity.

Because the expected inverse U-shaped relationship between the use of fixed-term employment and labor productivity is not found and some results suggest a weak negative relationship between both, we estimate the same regression models without including the *Share2* variable. The respective results are shown in Table 7.

[insert Table 7 about here]

In all models the coefficient of *Share* is negative, but only significant in the system GMM model treating all the share variable as exogenous. Thus our results provide no evidence for an inverse U-shaped relationship, nor for a positive or negative relationship. Thus, it follows that the share of employees with fixed-term contracts on total work force of an establishment has no significant impact on labor productivity.

With respect to the remaining control variables, *Size* is found to have negative and positive parameters, depending on the applied empirical method. In contrast, we find that when *Intermediate* is larger there is a positive effect on labor productivity in all estimates. This, however, might only control for the effect that higher turnovers are generated by using more intermediate inputs, which translates into higher productivity here, since labor productivity is defined as sales per capita. Another variable with significant coefficients in all models is *Export*. Hence, firms with a higher share on turnover abroad have a higher

productivity. Moreover, an increasing share of *Qualified* does also increase the productivity. Only in the fixed effect model the respective coefficient is not significant. The coefficient of *Part time* is negative and significant in all models. The coefficient of *Investment* is positive and significant in all models. The signs and magnitude of the coefficients of all control variables are not or only barely affected whether *Share2* is included or not.

With respect to the selection effect, we find the expected. The coefficient of the inverse Mills ratio is significant in the fixed effect approach. Hence, the estimation results are subject to a selection effect. Moreover, the coefficients of the inverse Mills ratio in the System GMM approach are not significant. This is what we expect, since by including the lagged dependent variable in the regression, a part of the distortion resulting from the selection is already captured.

In all system GMM estimations shown in Table 6 and 7, the null hypothesis of the Hansen test of over-identifying can not be rejected at a five percent level. Also the p-value of the test for autocorrelation is above five percent. This implies that, in general, the moment conditions are valid and the error terms are not auto correlated.

Robustness checks

Table 8 contains three robustness checks. In the first part the results without controlling for possible selection into the use of fixed-term employment via inverse Mills ratio are shown. The second and third parts provide separate estimation results for subsamples using only establishments located in West and East Germany. For each robustness check the fixed effects model and both system GMM specifications are estimated with and without *Share2*, the squared term of the share variable. In all models only the coefficients of *Share* and *Share2* as well as the number of observations and diagnostic statistics are reported. Control variables included in our base line models reported in Table 6 and 7 are also included in all models, but the respective coefficients are not reported here.[10]

[insert Table 8 about here]

Ignoring the problem of a potential selection effect leads to the expected inverse U-shaped relationship in the fixed effects model. The coefficient *Share*

[10] The coefficients are available upon request from the authors.

is positive while the coefficient of *Share2* is negative. Both are significant at the five percent level. But, however, in both system GMM models both *Share* and *Share2* have negative, but not significant, coefficients. Therefore, the same models are estimated without including *Share2*. The respective coefficient of *Share* is negative in all three models, but only significant in the first system GMM model, which treats all explanatory variables as exogenous except the lagged dependent variable. It follows that ignoring the selection effect would lead to incorrect conclusions regarding the relationship between productivity and the share of fixed-term workers.

Two further robustness checks are carried out by running separate regression models for West and East Germany. For this robustness check, all establishments located in Berlin are excluded because it is not possible to assign them to either West or East Germany. For each subsample, one fixed effects specification and two system GMM models are estimated with and without *Share2*. All models for both subsamples include the inverse Mills ration to control for selection into the use of fixed-term employment. The results for the West German subsample are reported in the second part of Table 8. In the models with both share variables, only the coefficient for the squared term of share in the first system GMM model is significant at the five percent level. The respective sign is negative. Excluding *Share2* results in insignificant coefficients for the *Share* variable in all models except the system GMM model treating the share variable as exogenous. In the third part of Table 8 the results for the East German subsample are provided. Again no evidence for the expected inverse U-shaped relationship or for a negative relationship is found. Including both share variables, all coefficients have the expected sign, but only one coefficient of *Share2* is significant. Excluding *Share2* leads to insignificant coefficients in all models for the East German subsample. So in general the robustness checks confirm our findings that there is no evidence for an inverse U-shaped relationship between the intensity fixed-term contracts are used and labor productivity. Evidence for a negative relationship is also not found.

It follows, that our hypothesis of an inverse U-shaped relationship between the share of employees with a fixed-term contract on total work force of an establishment and labor productivity has no support. This result is robust, regardless the estimation method applied or the subsample examined. Moreover, our results also suggest that there is not even a significant relationship between the use of fixed-term employment and labor productivity. However, the analysis has also

shown that the selection effect plays a role and ignoring this can potentially lead to false conclusions.

5 Conclusion

The importance of fixed-term contracts in filling vacancies, but also in terms of their share on total workforce, is increasing. The aim of this study is to analyze whether, and if so, to what extent, this development improves the productivity of companies. Put differently, is it in the companies' interest to use this instrument as intensively as possible because it promises to increases productivity?

In order to address this question, we review previous findings of labor market and management research. It shows that temporary employment, in general, is used for two reasons: to screen for productive employees and to handle demand fluctuations. In this respect, using fixed-term contract should positively affect productivity. The literature also suggests the existence of demotivating effects if fixed-term workers are used excessively, as well as decreasing firm-specific human capital with an increasing share of fixed-term workers. Based on the theoretical considerations and empirical findings on these effects, we derive the hypothesis of an inverse U-shaped relationship between the share of fixed-term workers on total workforce and productivity.

To test this hypothesis, we use a large dataset containing German establishments and apply several panel data models. The inherent selection problem is taken into account via the inverse Mills ratio and the inverse U-shape is modeled by two variables, the share of fixed-term workers and its square. Yet, the empirical analysis provides no support for the hypothesis. Rather, we find mostly negative coefficients for both variables modeling the share of fixed-term workers on total workforce, with the squared variable being weakly significant in a few estimations. It is then tested whether the relationship is not inverse U-shaped but negative. Again, no significant relationship is found, although the coefficients are still negative. Hence, our study reveals that there is no significant relationship between the use of fixed-term employment and labor productivity in the German case. This is in line with the findings of Kleinknecht et al. (2006) for Dutch firms. Since we see mostly negative coefficients, although not significant, it also partly confirms the findings of Cappellari et al. (2012) for Italy, where the relationship is found to be negative.

Yet, the question arises why there is no relationship found when labor- and management literature point to the negative and positive aspects of this instrument. The reason might be that the majority of fixed-term contracts in Germany are longer than one year. Hence, the positive effects of adjusting employment without redundancy costs still exists since a firm can lay off some of the fixed-term works every month (if hired a year before), but it would still have to pay some redundancy costs if it tries to terminate all of them in the event of demand slump. In this respect fixed-term employment is not as flexible as temporary agency work and, thus, the positive effects of increased flexibility are limited. But also the negative effect of lower firm specific human capital only partly apply with job tenures of one year, since much of this knowledge is transferred in the first few months. Moreover, since 50 percent of fixed-term workers in Germany are offered a permanent contract the screening and motivational aspects may also have only little effects. Overall the positive and negative aspects, discussed in the labor- and management literature only partly apply to fixed-term employment in Germany and, thus, the effects might not be as strong.

However, from a policy perspective, this result remains valid. An increasingly flexible labor market in continental European countries, like Germany, is constantly called for. In order to enhance this flexibility, the use of instruments like fixed-term contracts and temporary agency work was simplified by the government. Although this policy was mainly imposed to reduce unemployment and increase the flexibility of the labor market, positive effects for firms were also expected. The findings of this study show, in line with others, that fixed-term contract do not help firms to increase their productivity. From this perspective, therefore, a further expansion of this form of employment seems to be not necessary.

References

Addison, J. T., & Surfield, C. J. (2009). Atypical work and employment continuity. *Industrial Relations*, *48*(4), 655-683.

Albert, C., Carcía-Serrano, C., & Hernanz, V. (2005). Firm-provided training and temporary contracts. *Spanish Economic Review*, *7*, 67-88.

Amuedo-Dorantes, C. (2000). Work Transitions into and out of Involuntary Temporary Employment in a Segmented Market: Evidence from Spain. *Industrial and Labor Relations Review*, *53*(2), 309-325.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, *58*, 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*, 29-51.

Arulampalam, W., Booth, A. L., & Bryan, M. L. (2004). Training in Europe. *Journal of the European Economic Association*, *2*(2-3), 346-360.

Auer, P., Berg, J., & Coulibaly, I. (2005). Is a stable workforce good for productivity? *International Labour Review*, *114*(3), 319-343.

Bassanini, A., Nunziata, L., & Venn, D. (2009). Job protection legislation and productivity growth in oecd countries. *Economic Policy*, *24*(58), 349-402.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education.* New York: National Bureau of Economic Research.

Bellmann, L., Kohaut, S., & Lahner, M. (2002). *Das IAB-Betriebspanel - Ansatz und Analysepotenziale* (Vol. 250; G. Kleinhenz, Ed.). IAB.

Bentolila, S., & Saint-Paul, G. (1992). The macroeconomic impact of flexible labor contracts, with an application to Spain. *European Economic Review*, *36*, 1013-1053.

Bergmann, A., & Mertens, A. (2011). Job Stability Trends, Lay-offs, and Transitions to Unemployment in West Germany. *Labour*, *25*(4), 421-446.

Blundell, R., & Bond, S. (1998). Initial conditions and moments restrictions in dynamic panel data models. *Journal of Econometrics*, *87*, 115-143.

Boockmann, B., & Hagen, T. (2008). Fixed-term contracts as a sorting mechanisms: Evidence from job durations in West Germany. *Labour Economics*, *15*(5), 984-1005.

Booth, A. L., Francesconi, M., & Frank, J. (2002). Temporary Jobs: Stepping Stones or Dead Ends? *The Economic Journal*, *112*(480), F189-F213.

Briggs, D. C. (2004). Causal Inference and the Heckman Model. *Journal of Educational and Behavioral Statistics*, *29*(4), 397-420.

Brown, S., & Sessions, J. G. (2005). Employee Attitudes, Earnings and Fixed-Term Contracts: International Evidence. *Review of World Economics*, *141*(2), 296-317.

Bryson, A. (2013). Do temporary agency workers affect workplace performance? *Journal of Productivty Analysis*, *39*, 131-138.

Cappellari, L., Aringa, C. D., & Leonardi, M. (2012). Temporary employment, job flows and productivity: a tale of two reforms. *The Economic Journal*, *122*, F188ŰF215.

Damiani, M., & Pompei, F. (2010). Labour protection and productivity in EU economies: 1995-2005. *The European Journal of Comparative Economics*, *7*(2), 373-411.

DeCuyper, N., de Jong, J., Witte, H. D., Isakasson, K., Rigotti, T., & Schalk, R. (2008). Literatur rewiev of theory and research on the psychological impact of temporary employment: Towards a conceptual model. *International Journal of Management Reviews*, *10*(1), 25-51.

Dolado, J. J., & Stucchi, R. (2008, November). *Do temporary contracts affect tfp? evidence from spanish manufacturing firms.* (Discussion Paper No. 3832)

Engellandt, A., & Riphahn, R. T. (2005). Temporary contracts and employee effort. *Labour Economics*, *12*(3), 281-299.

Fischer, G., Janik, F., Müller, D., & Schmucker, A. (2009). The IAB Establishment Panel - Things Users Should Know. *Schmollers Jahrbuch*, *129*(1), 133-148.

Gash, V. (2008). Bridge or Trap? Temporary Workers Transitions to Unemployment and to the Standard Employment Contract. *European Sociological Review*, *24*(5), 651-668.

George, E. (2003). External Solutions and Internal Problems: The Effects of Employment Externalisation on Internal Workers'Attitudes. *Organisational Sience*, *14*(4), 386-402.

Gerfin, M., Lechner, M., & Steiger, H. (2005). Do subsidised temporary employment get the unemployed back to work? An economic analysis ot two different schemes. *Labour Economics*, *12*(6), 807-835.

Gundert, S., & Hohendanner, C. (2011). Soziale Teilhabe ist eine Frage von stabilen Jobs. *IAB Kurzbericht*, *4*, 1-8.

Hagen, T. (2003). Does Fixed-term Contract Employment Raise Firms' Adjustment Speed? Evidence form an Establishment Panel for West Germany. *Jahrbücher für Nationalökonomie und Statistik*, *223*(4), 403-421.

Hirsch, B., & Mueller, S. (2012). The Productivity Effect of Temporary Agency Work: Evidence from German Panel Data. *The Economic Journal*, *122*, F216-F235.

Houseman, S. N. (2001). Why Employers Use Flexible Staffing Arrangements: Evidence From An Establishment Survey. *Industrial and Labor Relations Review*, *55*(1), 149-170.

IAB. (2011). IAB-Aktuell 18.02.2011.

Ichino, A., & Riphahn, R. T. (2005). The effect of employment protection on worker effort: absenteeism during and after probation. *Journal of the*

European Economic Association, *3*(1), 120Ũ143.

Jones, M. K., Jones, R. J., Latreille, P. L., & Sloane, P. J. (2009). Training, Job Satisfaction, and Workplace Performance in Britain: Evidence from WERS 2004. *Labour*, *23*(s1), 139-175.

Kleinknecht, A., Oostendorp, R. M., Pradhan, M. P., & Naastepad, C. (2006). Flexible Labour, Firm performance and the Dutch Job Creation Miracle. *International Review of Applied Economics*, *20*(2), 171-187.

Lagos, R. (2006). A model of tfp. *The Review of Economic Studies*, *79*(4), 983-1007.

McGinnity, F., Mertens, A., & Gundert, S. (2005). A Bad Start? Fixed-Term Contracts and the Transition form Education to Work in West Germany. *European Sociological Review*, *21*(4), 359-374.

Mertens, A., Gash, V., & McGinnity, F. (2007). The Cost of Flexibility at the Margin. Comparing the Wage Penalty for Fixed-term Contracts in Germany and Spain using Quantile Regression. *Labour*, *21*(4/5), 637-666.

Mertens, A., & McGinnity, F. (2004). Wages and Wage Growth of Fixed-Term Workers in East and West Germany. *Applied Economics Quarterly*, *50*(2), 139-163.

Nielen, S., & Schiersch, A. (in press). Temporary Agency Work and Firm Competitiveness: Evidence from German manufacturing firms. *Industrial Relations*.

Nunziata, L., & Staffolani, S. (2007). Short-Term Contracts Regulations and Dynamic Labour Demand: Theory and Evidence. *Scottish Journal of Political Economy*, *54*(1), 72-104.

Ortega, B., & Marchante, A. J. (2010). Temporary contracts and labour productivity in spain: a sectoral analysis. *Journal of Productivty Analysis*, *34*, 199-212.

Picchio, M. (2008). Temporary Contracts and Transition to Stable Jobs in Italy. *Labour*, *22*(s1), 147-174.

Puhani, P. A. (2000). The Heckman Correction for Sample Selection and its Critique. *Journal of Economic Surveys*, *14*(1), 53-68.

Roodman, D. (2009a). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9*(1), 86-136.

Roodman, D. (2009b). Practitioner‘s Corner A Note on the Theme of Too Many Instruments. *Oxford Bulletin of Economics and Statistics*, *71*(1), 135-158.

Shire, K. A., Mottweiler, H., Schönauer, A., & Valverde, M. (2009). Temporary Contracts in Coordinated Market Economies: Evidence form front-line Service Workplaces. *Industrial and Labor Relations Review*, *62*(4), 602-617.

Städele, D., & Müller, D. (2006). *"Codebuch zum IAB-Betriebspanel." FDZ Datenreport*.

Vidal, M., & Tigges, L. M. (2009). Temporary Employment and Strategic Staffing in the Manufacturing Sector. *Industrial Relations*, *48*(1), 55-72.

Wang, R., & Weiss, A. (1998). Probation, layoffs, and wage-tenure profiles: A sorting explanation. *Labour Economics*, *5*(3), 359-383.

Wasmer, E. (2006). General versus Specific Skills in Labor Markets with Search Frictions and Firing Costs. *The American Economic Review*, *96*(3), 811-831.

Zwick, T. (2006). The Impact of Training Intensity on Establishment Productivity. *Industrial Relations*, *45*(1), 26-46.

Table 1: Channels and expected overall effect

channel	low share	high share
flexibility	+	+
screening	+	-
human capital	-	-
overall effect	+	-

Table 2: Descriptive statistics: Continuous variables

Variable		Mean	Std. Dev.	Min	Max		N
LaborProd	overall	150988.5	184445.4	76.90006	2724388	N =	8787
	between		175498.6	7563.579	2220908	n =	2244
	within		44082.6	-460682.5	1190880	T-bar =	3.91578
Share	overall	0.0367837	0.0749916	0	0.9931973	N =	8787
	between		0.0608276	0	0.6739306	n =	2244
	within		0.0471705	-0.4767171	0.768491	T-bar =	3.91578
Size	overall	231.2081	1261.51	5	46140	N =	8787
	between		1460.919	5	45024.67	n =	2244
	within		57.47266	-1493.792	2099.008	T-bar =	3.91578
Qualified	overall	0.7055241	0.2322374	0	1	N =	8787
	between		0.2117569	0	1	n =	2244
	within		0.1018012	-0.0224171	1.399363	T-bar =	3.91578
Part time	overall	0.0992271	0.1435632	0	1	N =	8787
	between		0.1306716	0	0.9706714	n =	2244
	within		0.0646558	-0.653587	0.7658938	T-bar =	3.91578
Export	overall	0.1901104	0.257645	0	1	N =	8787
	between		0.2495662	0	1	n =	2244
	within		0.0686554	-0.3598896	0.9101104	T-bar =	3.91578
Investment	overall	5903.908	14799.74	0	714285.7	N =	8787
	between		12518.02	0	410714.3	n =	2244
	within		10215.98	-297667.5	309475.3	T-bar =	3.91578
Intermediate	overall	52.72061	19.09313	1	100	N =	8787
	between		17.27151	3.8	100	n =	2244
	within		9.056647	5.97061	106.0539	T-bar =	3.91578
Mills ratio	overall	1.82969	0.278848	1.595769	4.494524	N =	8787
	between		0.2861854	1.595813	4.48323	n =	2244
	within		0.0513003	1.184234	2.240196	T-bar =	3.91578

Notes: No. of observations: 8787; No. of establishments: 2244

Table 3: Descriptive statistics: Dummy variables

Variable	Mean	Std. Dev.	Min	Max	N
Age1	0.0458632	0.2092003	0	1	8787
Age2	0.0888813	0.2845885	0	1	8787
Age3	0.1903949	0.3926350	0	1	8787
Age4	0.1301923	0.3365341	0	1	8787
Age5	0.5446683	0.4980291	0	1	8787
Closed	0.0125185	0.1111899	0	1	8787
Outsourced	0.0133151	0.1146269	0	1	8787
Spin	0.0070559	0.0837072	0	1	8787
Integrated	0.0256060	0.1579658	0	1	8787
Owned1	0.2998748	0.4582290	0	1	8787
Owned2	0.5712985	0.4949186	0	1	8787
Owned3	0.0995789	0.2994548	0	1	8787
Owned4	/	/	/	/	/
Owned5	0.0179811	0.1328902	0	1	8787
Owned6	0.0091044	0.0949868	0	1	8787
West	0.50643	0.4999871	0	1	8787
Tarif1	0.3737339	0.4838218	0	1	8787
Tarif2	0.0938887	0.2916904	0	1	8787
Tarif3	0.5323774	0.498979	0	1	8787
WorkConcil	0.3996813	0.4898607	0	1	8787

Notes: Due to the private policy rules of the IAB, the descriptive statistics of some variables are not publishable due to the small number of cases in the respective subgroups

Table 4: Descriptive statistics: Federal states

State	N	Percent
Schleswig-Holstein	183	2.08
Hamburg	60	0.68
Lower Saxony	766	8.72
Bremen	198	2.25
North Rhine-Westphalia	838	9.54
Hesse	468	5.33
Baden-Württemberg	782	8.90
Bavaria	600	6.83
Saarland	134	1.52
Rhineland-Palatinate	348	3.96
West	4377	49.86
Berlin	284	3.23
Brandenburg	593	6.75
Mecklenburg-Western Pomerania	389	4.43
Saxony	1210	13.77
Saxony-Anhalt	773	8.80
Thuringia	1161	13.21
East	4126	46.91
Total	8787	100

Table 5: Descriptive statistics: Share per industry

	all firms					only firms using fixed-term contracts				
Industry	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
food/luxury	949	0.0450	0.0999	0.0000	0.9500	438	0.0976	0.1285	0.0034	0.9500
textiles/clothing	273	0.0350	0.0674	0.0000	0.4348	127	0.0753	0.0821	0.0034	0.4348
paper/printing/	451	0.0273	0.0671	0.0000	0.8451	198	0.0622	0.0901	0.0016	0.8451
wood sector	477	0.0282	0.0777	0.0000	0.9756	141	0.0956	0.1185	0.0062	0.9756
chemical/pharmaceutical sector	521	0.0415	0.0701	0.0000	0.6000	309	0.0699	0.0793	0.0022	0.6000
plastics industry	483	0.0465	0.0733	0.0000	0.8667	312	0.0721	0.0805	0.0025	0.8667
glass/stones/ore extraction	483	0.0450	0.0831	0.0000	0.6667	235	0.0924	0.0992	0.0011	0.6667
manufacture of basic metals	645	0.0429	0.0861	0.0000	0.9932	358	0.0772	0.1034	0.0005	0.9932
recycling	93	0.0381	0.0826	0.0000	0.4500	27	0.1313	0.1070	0.0152	0.4500
manufacture of fabricated metal	1202	0.0320	0.0528	0.0000	0.4688	540	0.0711	0.0585	0.0020	0.4688
machinery and equipment	1283	0.0281	0.0457	0.0000	0.4286	693	0.0520	0.0512	0.0009	0.4286
motor vehicles, trailers and semitrailers	366	0.0484	0.0645	0.0000	0.3804	245	0.0724	0.0670	0.0013	0.3804
other vehicle production	147	0.0493	0.1213	0.0000	0.8333	82	0.0884	0.1517	0.0021	0.8333
manufacture of electrical equipment	590	0.0388	0.0711	0.0000	0.5238	303	0.0755	0.0841	0.0025	0.5238
precision and optical equipment	522	0.0207	0.0391	0.0000	0.2642	194	0.0556	0.0467	0.0026	0.2642
furniture, jewelry/toys	302	0.0497	0.1392	0.0000	0.9524	120	0.1251	0.1988	0.0029	0.9524

Table 6: Estimation results with controlling for the selection into fixed-term employment via inverse Mills ratio

Variable	1	2	3	4	5
L1 LaborProd				0.4179***	0.4236***
				(0.0782)	(0.0779)
Share		0.1033	0.2010	-0.0045	-0.0063
		(0.1958)	(0.1293)	(0.1480)	(0.2634)
Share2		-1.4321	-1.2969*	-0.9245	-1.3010
		(1.1576)	(0.7177)	(0.7394)	(1.2686)
Size	0.6263***	0.0603***	-0.3430***	0.0382***	0.0380***
	(0.0212)	(0.0072)	(0.0443)	(0.0107)	(0.0108)
Intermediate	0.1074***	0.4171***	0.0363***	0.2130***	0.2115***
	(0.0404)	(0.0171)	(0.0136)	(0.0274)	(0.0273)
Qualified	-0.3991***	0.5342***	0.0440	0.2969***	0.2943***
	(0.1224)	(0.0517)	(0.0382)	(0.0602)	(0.0603)
Part time	0.0533	-1.5038***	-0.1316	-0.7436***	-0.7373***
	(0.1677)	(0.0706)	(0.0582)	(0.1206)	(0.1204)
Export	0.3446***	0.4401***	0.2845***	0.3163***	0.3145***
	(0.1032)	(0.0433)	(0.0647)	(0.0613)	(0.0610)
Investment	0.0192***	0.0222***	0.0042***	0.0071***	0.0070***
	(0.0048)	(0.0020)	(0.0012)	(0.0019)	(0.0019)
company agreement	-0.1580***				
	(0.0594)				
no agreement	-0.0570				
	(0.0397)				
Mills		0.0363	0.4000***	0.0269	0.0262
		(0.0223)	(0.0934)	(0.0272)	(0.0272)
Age Dummies	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes
Restructuring Dummies		Yes	Yes	Yes	Yes
Federal State Dummies	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Ownership Dummies	Yes	Yes	Yes	Yes	Yes
Work Council	Yes	Yes	Yes	Yes	Yes
Constant	-2.7274***	8.9692***	11.9967***	5.3211****	5.2701***
	(0.2347)	(0.1005)	(0.3339)	(0.7503)	(0.7469)
No. of observations	8787	8787	8787	6182	6182
No. ID			2244	2121	2121
(Pseudo) R-squared	0.3203	0.5102	0.1272		
Wald chi2	2503.92***			7625.51***	7764.43***
No. of instruments				61	69
Hansen test p-value				0.439	0.205
AR(2) test p-value				0.940	0.924

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Columns: (1): Probit; (2): OLS; (3): FE; (4): SysGMM exogen; (5): SysGMM predetermined.

Table 7: Estimation results with controlling for the selection into fixed-term employment via inverse Mills ratio

Variable	1	2	3	4
L1 LaborProd			0.4195***	0.4215***
			(0.0779)	(0.0779)
Share	-0.1301	-0.0108	-0.1543**	-0.2342
	(0.1171)	(0.0741)	(0.0779)	(0.1652)
Size	0.0612***	-0.3398***	0.0387***	0.0394***
	(0.0073)	(0.0442)	(0.0107)	(0.0110)
Intermediate	0.4173***	0.0370***	0.2126***	0.2122***
	(0.0171)	(0.0137)	(0.0274)	(0.0273)
Qualified	0.5339***	0.0448	0.2943***	0.2922***
	(0.0517)	(0.0381)	(0.0599)	(0.0601)
Part time	-1.5077***	-0.1336**	-0.7418***	-0.7390***
	(0.0707)	(0.0579)	(0.1202)	(0.1202)
Export	0.4405***	0.2834***	0.3160***	0.3161***
	(0.0433)	(0.0647)	(0.0612)	(0.0611)
Investment	0.0223***	0.0043***	0.0071***	0.0071***
	(0.0020)	(0.0012)	(0.0019)	(0.0019)
Mills	0.0354	0.4066***	0.0260	0.0248
	(0.0223)	(0.0936)	(0.0272)	(0.0273)
Age Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
Restructuring Dummies	Yes	Yes	Yes	Yes
Federal State Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Ownership Dummies	Yes	Yes	Yes	Yes
Work Council	Yes	Yes	Yes	Yes
Constant	8.9674***	11.9632***	5.3049***	5.2889***
	(0.1004)	(0.3343)	(0.7474)	(0.7472)
No. of observations	8787	8787	6182	6182
No. ID		2244	2121	2121
R-squared	0.5101	0.1263		
Wald chi2			7650.26***	7694.62***
No. of instruments			60	64
Hansen test p-value			0.438	0.362
AR(2) test p-value			0.941	0.934

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Columns: (1): OLS; (2): FE; (3): SysGMM exogen; (4): SysGMM predet.

Table 8: Robustness checks

	Share	Share2	N	R-squared/ Wald chi2	No. of Inst.	Hansen test p-value	AR(2) test p-value
Without controlling for potential selection into the use of fixed-term contracts							
FE	0.2730**	-1.5532**	8787	0.1173			
	(0.1279)	(0.7152)					
GMM_a	-0.0129	-0.9048	6182	7620.28***	60	0.434	0.934
	(0.1480)	(0.7395)					
GMM_b	-0.0089	-1.2969	6182	7758.73***	68	0.202	0.918
	(0.2631)	(1.2701)					
FE	0.0089		8787	0.1161			
	(0.0747)						
GMM_a	-0.1594**		6182	7644.70***	59	0.432	0.935
	(0.0768)						
GMM_b	-0.2360		6182	7689.13***	63	0.361	0.929
	(0.1651)						
Only establishments located in West Germany (with selection control)							
FE	0.1457	-0.5055	4377	0.1795			
	(0.1411)	(0.5915)					
GMM_a	0.0455	-1.8451**	3029	12008.36***	55	0.984	0.054
	(0.1821)	(0.8954)					
GMM_b	-0.5158	1.0012	3029	11685.98***	63	0.297	0.048
	(0.3332)	(2.0232)					
FE	0.0690		4377	0.1794			
	(0.0774)						
GMM_a	-0.2241**		3029	11526.73***	54	0.985	0.056
	(0.9841)						
GMM_b	-0.3577		3029	11435.49***	58	0.712	0.050
	(0.2322)						
Only establishments located in East Germany (with selection control)							
FE	0.2253	-1.7132*	4126	0.1277			
	(0.1740)	(0.8856)					
GMM_a	0.0311	-0.7750	2956	2256.36***	50	0.108	0.728
	(0.2138)	(1.0062)					
GMM_b	0.2673	-2.5998	2956	2343.57***	58	0.183	0.761
	(0.3879)	(1.7106)					
FE	-0.0881		4126	0.1260			
	(0.1013)						
GMM_a	-0.1044		2956	2271.95***	49	0.104	0.727
	(0.1131)						
GMM_b	-0.2598		2956	2312.60***	53	0.123	0.731
	(0.2334)						

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

GMM_a: System GMM exogenous; GMM_b: System GMM predetermined