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## Temporary Agency Work and Firm Competitiveness

### Evidence from German Manufacturing Firms

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# Temporary Agency Work and Firm Competitiveness: Evidence from German manufacturing firms[†]

**Sebastian Nielen and Alexander Schiersch[‡]**

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**Abstract**

This paper addresses the relationship between the utilization of temporary agency workers by firms and their competitiveness measured by unit labor costs, using a rich, newly built, data set of German manufacturing enterprises. The analysis is conducted by applying different panel data models while taking the inherent selection problem into account. Making use of dynamic panel data models allows us to control for firm specific fixed effects as well as for potential endogeneity of explanatory variables. The results indicate a U-shaped relationship between the extent that temporary agency workers are used and the competitiveness of firms.

**Keywords:** temporary agency work, competitiveness, firm performance, manufacturing

**JEL Classification:** D24, L23, L60

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# 1. Introduction

Temporary agency work is a tool that allows firms to adjust labor input on short notice. In Germany it has become increasingly important since 1994, when regulations concerning temporary employment were relaxed. Between 1994 and 2007, the number of temporary agency workers in Germany quadrupled from roughly 175,000 to over 700,000. Though, it must be noted that despite this growth, only 2.4 percent of the working population in 2007 were hired by temporary agencies (Schmidt and Wüllerich 2011). The growth in the use of temporary agency workers is by no means only a German phenomenon; it can be observed throughout the industrialized world. The share of temporary agency workers in Japan, for example, grew in the active population by more than 1.3 percentage points to 2.1 percent between 2000 and 2007. In European countries like Switzerland, Austria, Finland and Italy, the growth in temporary agency work was 0.7 percentage points over the same period. (Eichhorst et al. 2010).

The increasing importance of temporary work is of growing interest to economists. Although there is an extensive discussion on this form of employment, the discussion is driven by a labor market perspective. Hitherto, there are two published papers, Arvantis (2005) and Kleinknecht et al. (2006) that analyze the effect of temporary agency work on firm performance. Arvantis (2005), based on 1,382 Swiss firms across all sectors, uses a dummy variable to model the utilization of temporary agency work on the outcome variable sales per capita by running a OLS regression. He finds no significant difference between firms using temporary agency work and those not using it. Kleinknecht et al. (2006) uses a different measure for temporary agency work. Here the percentage of hours worked by temporary agency workers out of total working hours is used. Based on a sample of 590 Dutch firms, OLS models are used to test for a relationship between the utilization of temporary agency work and firm performance as measured by sales growth and growth in employment. Like Arvantis (2005), no significant effects of temporary agency work on firm performance are found.

We extend the existing literature on the effects of temporary employment on firm performance by applying panel data models on a rich newly combined panel data set of more than 17,000 German manufacturing enterprises. In contrast to the aforementioned studies, we control for the inherent selection problem into using temporary agency work, since some firms systematically do not use this instrument. Additionally, we apply dynamic panel data models to control for potential endogeneity of explanatory variables. We find a U-shaped relationship between the extent of using temporary agency workers and competitiveness measured by unit labor costs. This result is robust with respect to the different models applied.

The remainder of the paper is organized as follows. The next section reviews the broad range of discussions in connection with temporary agency work and fixed-term employment. From this, we develop the hypothesis to be tested. The third section presents related studies. In the fourth section, the data are introduced and first descriptive statistics are presented. The results of the analysis are the subject of the fifth section and the last section provides some conclusions.

## 2. Literature and Hypothesis Development

In this section we summarize the discussion in literature on the effects of temporary agency work on employees and firms and use them to derive our hypothesis about the relationship between firm performance and temporary agency work. In the context of this paper, the performance of firms is approximated by unit labor costs (ULC). ULC is a widely used measure of competitiveness between countries and industries (Felipe 2007, Ark et al. 2005, Alesina and Perotti 1997).[1] It is constructed by dividing the cost of labor, including all benefits, by real value added.[2] Hence, ULC is driven by wages as well as by labor productivity.[3] This supports the idea of competitiveness, since, as pointed out by Ark et al. (2005, 2): "…competitiveness is not only determined by productivity, but also by the cost of inputs in the production process. Indeed, a well-known measure of international competitiveness combines labour cost and productivity into a single measure of labour cost per unit output."[4] Hence, competitiveness increases with a decreasing ULC and this occurs when labor productivity grows faster than wages.

Utilizing this measure raises the question if the costs of temporary agency workers are not below that of employees with permanent contracts, even if both are equally productive. If this is the case, one could argue that the increase in the share of temporary agency workers would necessarily lead to better ULC's. Firstly, with respect to the costs, we must distinguish between the costs of temporary agency workers for the hiring companies and the wage of these employees. Many studies show that the wages of temporary agency workers are considerably below that of their permanent employed colleagues (Antoni and Jahn 2009, Brown and Sessions 2005, Jahn and Rudolph 2002). Jahn and Rudolp (2002) find that wages of temporary agency employees in Germany are roughly one third below that of permanent employees. However, as pointed out by Nollen (1996), the cost saving goal of hiring companies are often not met. This "disappointing experience appear to occur in Europe as well as in the U.S." (Nollen 1996, 578). The reason is that the client company does not pay the low wages directly. Instead, the client company pays a fee that includes the gross wage of the temporary worker and additional fees, depending on the contract, to the agency. The overhead fees are sometimes quite high, as pointed out by Houseman (2001). According to Rangnitz (2008), only two-thirds of the fee paid by the client company to the agency is the actual wage of the temporary worker and the rest are costs and profit of the agency. This means, in turn, that actual costs for a temporary agency worker, compared to a similar worker under a permanent contract, are at least the same or higher. This is also confirmed in an empirical study by Klein-

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1 ULC as indicator for competitiveness is, for instance, provided and used by the OECD or the Bureau of Labor Statistics. See: http://stats.oecd.org/mei/default.asp?rev=3, http://www.bls.gov/news.release/prod4.t03.htm,

2 For international comparisons the purchasing power parity and exchange rates must also be considered. See for an introduction see Ark et al. (2005).

3 The relationship between wages and labor productivity is as follows: ULC, as defined here, is formally $ULC = w_n L/(VA_n/P)$, with the enumerator capturing labor costs and the denominator the real value added. This can easily be transformed into $ULC = w_n/((VA_n/P)/L)$ and $ULC = w_n/(Q/L)$ by substituting real value added by quantities (Felipe 2007).

4 We are aware of the critics and limitations of ULC. First, changes in the second input category, capital, are not explicitly taken into account. Second, the way ULC is defined it can also be interpreted as a measure of the share of labor income on output (Felipe 2007). We address these issues by considering the capital intensity of production as an explanatory variable in the estimation.

knecht et al. (2006, 176) that find "evidence that flexible contracts lead to significant savings on firm's wage bill. This holds for people on truly temporary contracts and for self-employed ('free lance') people. It does not, however, hold for people hired from manpower agencies."

If saving labor costs is not the driving force behind the use of temporary agency work, it must have other features. Within the extensive literature on the various aspects of temporary employment and temporary agency work, there are three discernable fundamental lines of argumentation.[5] The first line develops along the increase of labor market flexibility through temporary employment. Thereafter, the temporary employment or temporary agency work is a form of external flexibility, which allows companies to react quickly to fluctuations in demand with an adjustment of labor input without prohibitive high redundancy costs (Pfeifer 2005, Nollen 1996, Bentolila and Saint-Paul 1992). Empirical evidence also suggests a positive correlation between permanent employment protection and the use of temporary employment (Shire et al. 2009, Nunziata and Staffolani 2007, Booth et al. 2002b, Houseman 2001). Hence, this form of employment is actually a result of strict labor market regulation. The flexibility argument supports the utilization of temporary agency work, since it allows firms to react quickly to changes in output demand by adjusting the cost of labor inputs. With respect to our performance measure, ULC, it directly affects the numerator. Hence, the competitiveness of firms using temporary employment should increase compared to those not using it, whenever changes in demand occur. There are, however, also ambiguous aspects to the use of temporary agency work that affect firm performance.

This introduces the second major strand of literature on temporary work: its screening aspect. Here, following the principal agent theory, the true quality of job applicants is unknown. Temporary agency workers, or fixed-term contracts, are used to increase the period of probation in order to give the employer more time to screen the employees (Vidal and Tigges 2009, Houseman et al. 2003, Booth et al. 2002a). If the temporary employees can expect that productive behavior and positive work attitudes will increase job tenure, or increase the probability of getting a permanent contract, screening helps to separate good from bad agents (Pfeifer 2005, Wang and Weiss 1998). This, in turn, would positively affect productivity both in the period of screening as well as afterwards (Engellandt and Riphan 2005). However, if firm policy or recent events prove that fixed-term contracts or temporary agency work is not used to screen for the productive workers but are rather substitutes for permanent contracts, the positive incentives of screening fail to appear (Vidal and Tigges 2009, Booth et al. 2002a). Such substitution could also discourage remaining core workers and the resulting "low levels of job satisfaction and morale may exert an adverse influence on productivity levels." (Brown and Sessions 2005, 311). This effect however, is conditional "upon the proportion of temporary workers and upon permanent workers' assumptions concerning the reasons for hiring temporary workers" (DeCuyper et al. 2008, 39). Thus, using too many temporary agency

[5] Although this paper focuses on temporary agency work, which is defined as a triangular relationship between worker, leasing company and client (Burgess and Connell 2005), we do not explicitly distinguish between fixed-term contracts and temporary agency work in this literature review, because the discussed effects are rather similar for both forms of employment. This paper does not discuss the institutional framework and its development in Germany. For more information on this see Schmidt and Wüllerich (2011), Antoni and Jahn (2009), Mitlacher (2008) and Pfeifer (2005).

worker will have a negative effect on the productivity of all workers and therefore decreases firms competitviness via decreased firm productivity. This is reflected in our measure of competitiveness by a decreasing denominator and, hence, an increasing ULC.

Finally, the productivity of firms also depends on firm-specific human capital. The literature argues that this kind of human capital is lower for temporary employed persons than for permanent employees (Nunziata and Staffolani 2007, Pfeifer 2005). Moreover, as pointed out by Nunziata and Staffolani (2007, 76), temporary employees indirectly affect productivity, since "the productivity of the newly hired temporary employees depends on the number of permanent employees who can dedicate part of their working time to train them to workplace tasks." This implies a transfer of firm specific knowledge from the permanent employees to the temporary employees, for which interaction between both groups is needed. This level of interaction, however, is already low in normal situations (Mitlacher 2008). Hence, knowledge transfer is restricted and productivity of temporary employees does not increase. Again, due to a decreasing productivity, firms' competitiveness should decrease with an increasing share of temporary workers.

<insert Table 1 about here >

To sum up, temporary agency work affects firm competitiveness through different mechanisms and, as shown in Table 1, the overall effect depends on the share of temporary workers on firms' workforce. Hence, the use of temporary agency workers has a positive effect since it allows for greater flexibility and it allows firms to screen new employees. On the other hand, using temporary agency workers will decrease firms' productivity via lower firm specific human capital. Further, an ever increasing share of temporary agency workers reduces internal motivation and also decreases productivity. Essentially firms face a trade-off between increased flexibility and the possibility to screen new employees on the one hand, with less firm specific human capital and less motivated employees on the other. To what extent the positive or negative effects prevail ultimately depends on share of temporary agency workers. We therefore expect to find a nonlinear, perhaps U-shaped relationship between ULC and the extent that temporary agency workers are used by the firms.

## 3. Related Studies

As shown above, a large and growing body of the literature is devoted to the relationship between temporary agency work, labor market performance and the situation of temporary employees. There is, however, only limited research on the effect of temporary agency work on the performance of the firms using temporary employees. To our knowledge, there are, so far, only two published papers in refereed journals.

The first is Arvantis (2005) who, using data on 1,382 Swiss firms across all sectors, evaluates the effect of the use of temporary agency workers on the performance and the innovative activity of the firms. The variable of interest is a dummy variable that takes the value of one if companies reported that temporary agency work is *important* for them. The output variable is

sales per capital, which approximates labor productivity. Using OLS, his results indicate that temporary agency work has no significant effect on the output variable sales per capital. The second is a study based on 590 Dutch firms from different sectors for the years 1992-1994 by Kleinknecht et al. (2006). They also used an OLS approach to analyze the effect of temporary agency workers on sales growth. The explanatory variable measuring the input of temporary workers was the percentage of hours worked by temporary agency workers on total hours worked. They also did not found a positive effect on their output variable. However, they find a weak, but negative, relationship between the use temporary agency workers and sales growth among non-innovators, while the effect on employment growth is insignificant. According to Kleinknecht et al. (2006), this suggests that labor productivity might be negatively affected by hired labor from manpower agencies.

Besides these published papers, we are aware of three discussion papers on this topic. Bryson (2007) uses data from approximately 1500 British companies in his study to measure the potential effect of temporary agency work on firm performance. Using OLS on the endogenous variables log sales per employee and log gross value added per worker, respectively, temporary agency work is modeled by three dummy variables that take the value of one if a company has none, 1-4 percent or five or more percent of temporary workers on total workforce. The results indicate that there is no significant effect of the use of temporary worker on firm's performance.

For Germany, Beckmann and Kuhn (2009) were the first to analyze the effect of temporary agency work on firm performance. They use a large data set of German establishments, the IAB panel of the Institute of Employment Research with almost 12,000 companies, but only 25,000 observations for the 2002 to 2005 period. Hence, the average number of observations per firm is 2.1. They model a Cobb-Douglas production function where log sales is the output variable, explained by various control variables and two variable categories that cover temporary workers. First, the share of temporary workers on total workforce and its quadratic term is included. Second, four dummy variables are defined that take the value of one if a company employs no temporary workers, 1-10 percent, 11-30 percent or more than 30 percent of temporary workers on total workforce. Using OLS, as well as a fixed effect and random effect models, they find an inverse U-shaped relationship between changes in sales and the share of temporary workers on total workforce.

Finally, Hirsch and Müller (2010) investigate the effect of temporary agency work on firm performance, using the same data set as Beckmann and Kuhn (2009), but just for the 2003 to 2007 period. As in Beckmann and Kuhn (2009), the analysis is based on a Cobb-Douglas function and various controls, with the difference that the dependent variable is now log gross value added. Again, the effect of temporary agency work is modeled by dummy variables. While Beckmann and Kuhn (2009) model the intensity that temporary agency workers are used by defining four dummy variables, Hirsch and Müller (2010) define 10 dummy variables. Beginning with a dummy variable for the non-use of temporary workers, the classification is done in steps of 2.5 percent share of temporary agency workers on total workforce, until the dummy variable for a share of more than 20 percent. As in Beckmann and Kuhn (2009), OLS and fixed effect regressions are estimated. The authors claim to find a significant hump-

shaped relationship between the extent of the use of temporary agency workers and firm productivity.

These studies all have a number of weaknesses. The published papers rely on limited samples and suffer from unobserved firm heterogeneity as a result of applying OLS. This could be overcome using panel models. Furthermore, neither the published nor the unpublished studies distinguish between companies that use temporary employees and those that do not. Hence, the analyses are subject to a self-selection bias. In addition to these general shortcomings, the German studies also suffer from using a data set that is simply not suitable for this particular research question. This is because of the questioning in the survey regarding the use of temporary agency work. Before 2004 the survey explicitly asked for temporary agency worker use in the workforce during the first half of the particular year. The question changed in 2004 and subsequent years to ask if any temporary agency workers were being used on June 30 of that year. We know, however, that the employment duration of more than 50 percent of all temporary agency workers is shorter than 3 months (Schmidt and Wüllerich 2011). Hence, most firms that actually have used temporary agency workers before or after June 30 are treated as non-users. Thus, the use of this input factor by the company is massively underestimated and the results of the analyses are therefore at least strongly biased.

Given these shortcomings, we enhance the existing literature on the effects of temporary employment on firm performance in three respects. First, this study accounts for the self-selection bias by (a) using a probit model to estimate the inverse mills ratio that is included in subsequent estimates to account for the selection bias and (b) by using just the subset of firms that used temporary agency workers. Second, we control for potential endogeneity of independent variables and dynamic effects by using system GMM models. Finally, and with respect to the German studies mentioned, we use a data set with more than 17,000 firms and 81,000 observations that actually capture the spending on temporary agency work over a year and thus does not confuse date data with annual data. Hence, our study allows, for the first time, valid conclusions about the relationship between the firm performance and the utilization of temporary agency work for Germany companies.

## 4. Data

This study uses a newly constructed data set of German Manufacturing enterprises. It contains data from the German Cost Structure Census (*Kostenstrukturerhebung*), the German Production Census (*Produktionserhebung*) and the Monthly Reports of German Manufacturing enterprises (*Monatsbericht*).[6] Each data set was gathered and complied by the Federal Statistical Office and the statistical offices of the states (*Statistisches Bundesamt, Statistische Landesämter*). We use the data for the 1999 to 2006 period. Plant and firm level data are merged using a common identifier. This combined data set covers all large German manufacturing firms with 500 or more employees over the entire time span. Smaller firms with more than 20 employees

[6] The data are confidential and can only be used by remote data processing. However, they are not exclusive. For more information see Zühlke et al. (2004) and http://www.forschungsdatenzentrum.de/en/index.asp.

are included as a random subsample that is held constant for four years.[7] The samples are designed to be representative for each sector.

The most important data set is that of the Cost Structure Census (CSC). It contains information on several input categories, such as expenditures for material inputs, wages and benefits, costs for temporary agency workers, depreciation, etc.[8] The Production Census contains information on the good produced, based on the nine-digit product classification system (*Güterverzeichnis für Produktionsstatistiken*) of the Federal Statistical Office. It provides information about the number of products produced by companies. The Monthly Reports contains information on domestic sales and foreign sales. This allows us to measure the export intensity of firms. To use methods of panel data analysis, the combined data set has been limited to those companies for which at least four observations are available. Thus, although the data set used covers more than 17,000 companies and contains more than 81,000 observations, it can no longer be regarded as representative for the entire manufacturing sector.

Given this data set, we construct the competitiveness measure ULC by using gross value added deflated by the producer price index at a two digit industry classification and the sum of all labor costs. The latter include wages, social security expenditures, provisions for firm pensions etc. As described above, we also include the costs of temporary agency workers in the denominator. The explanatory variables are: the size of a company (Size) measured by the number of employees; the number of products (NoProducts); the average labor costs (AvageLaborCosts); the share of outsourced activities like repair and costs for contract work performed by other companies on gross value added (External); the capital intensity of production (CapitalIntensity) calculated as quotient of capital stocks[9] and the number of employees; the material intensity of production as share of material costs and energy on sales (IntermediateIntensity) and the export intensity as share of foreign sales on total sales (ExportIntensity). We apply the logarithm of these variables in the analysis.

Further we use dummy variables for the legal form (LegalForm) of the company; dummy variables for the years (YearDummies) and the industries (IndustryDummies) as well as dummy variables for the establishment profile (EstablishmentProfile). Finally the inverse mills ratio (InversMillsRatio) is calculated and used as explanatory variable to account for the selection bias. According to the definition of ULC, we measure the share of temporary agency workers on total firm employment, by dividing the costs for temporary agency workers with the sum of labor costs for permanent employees and costs for temporary agency workers (Share). Since we expect the relationship between firm's competitiveness and the share of temporary agency workers on the total workforce to be nonlinear, we also used the squared Share variable (Share2).

The descriptive statistics of the explanatory variables are shown in Table 2. Table 3 contains the descriptive statistics, by industry, of the "Share" variable.

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7 The Subsamples are compiled in 1999 and 2003.

8 For more information about the Cost Structure Census surveys in Germany, see Fritsch et al. (2004).

9 The capital stock is not given in the data. It is approximated by a program recently published by Wagner (2010a).

<insert Table 2 and Table 3 about here >

# 5. Empirical Investigation

To analyze the relationship between the extent of using temporary agency work and ULC we proceed in three steps. The subsequent section presents the empirical strategy and the applied methods. Using the strategy outlined in section 5.1, we present and discuss the estimation results in section 5.2. Finally, the last subsection presents the results of robustness checks.

## 5.1. Methods and Empirical Strategy

As noted before, previous studies do not account for the fact that some firms have never used temporary agency work and that this causes a self-selection bias. In our data set about 65 percent of all companies have used temporary agency worker at least once. It follows that the analysis is also subject to a self-selection problem. Therefore, our analysis starts in section 5.2 with the estimation of a probit selection equation, where the dependent variable is a binary one that takes the value one if a firm uses temporary agency worker in a year and zero otherwise.[10] Given the estimates we calculate the inverse mills ratio based on the selection model as proposed by Heckman (1979). For details of this approach see Briggs (2004). This ratio is than included in subsequent estimations as an additional variable to control for the possible selection effect.

After calculating the inverse mills ratio, the estimation strategy for measuring the effect of temporary agency work on firm's competitiveness is as follows: First, we estimate an OLS regression model including all control variables to gain an impression of the relationship between the variables of interest, share, share squared and ULC. Then, we estimate a fixed effect regression in order to control for firm specific effects. The estimation is conducted taking into account all control variables, as described in section 4. Since there is variation over time, the dummy variables are also included.[11]

However, fixed effect models do not take into account the possible endogeneity of regressors or dynamic aspects. Therefore, we also make use of dynamic panel data models. A natural choice is the difference GMM estimator proposed by Arellano and Bond (1991). Here, the estimation equation is transformed into first differences. In order to account for the dynamic effects, the (differenced) lagged depended variable is included as an additional explanatory variable. Since it is endogenous by nature, it is instrumented with its own values of lag order two and higher. Starting with lag order one, the same applies to all exogenous variables suspected to be endogenous.

One critical point of the difference GMM estimator, as well as of the fixed effect estimator, is, however, the elimination of level information by subtracting means over time or first differ-

[10] We do not make use of all available variables in the selection equation because variables in the selection model and in the regression models shouldn't be identical in order to avoid multicollinearity between the mills ratio and the other exogenous variables (Briggs 2004, Puhani 2000).

[11] The fixed effect model was also estimated without dummy variables. We do not report the results, since the level of the coefficients changes minimally, while signs and significances do not change.

ences. Using the level information could improve estimations. Therefore we apply the estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998), called system GMM.[12] System GMM estimates a model in first differences and one in levels simultaneously using additional moment conditions compared to difference GMM. Following Blundell and Bond (1998), the lagged values of the variables are used as instruments for the differenced variables in the difference model, while in the level model lagged differences are used as instruments for the variables in levels. For all specifications the *p*-values of the Hansen test of overidentifying restrictions will be reported. It is also important to test for first order autocorrelation of the error terms in levels. This is done by a test for second order autocorrelation of first differences.

The actual analysis, based on system GMM, comprises two estimates. First, a model is estimated where the potential endogeneity of regressors is ignored. The potential selection problem is solved by means of the inverse mills ratio according to the procedure described by Semykina and Wooldridge (2010). In the second GMM estimate we additionally assume that some of the regressors are not strictly exogenous, but predetermined. This means they are correlated with past error terms but not with current ones. The results are compared with each other and the results of the fixed effect model.

Given the estimates of section 5.2, section 5.3 contains various robustness tests. As a first robustness check, we estimate the above outlined models without controlling for the potential selection problem. Additionally we estimate each model while reducing the sample to those firms that actually used temporary agency work at least once in the observation period. Finally, we estimate separate models for research-intensive and non-research-intensive firms. It follows the idea that companies in research-intensive industries face a different kind of competition than the ones in non-research-intensive industries and hence might make use of the instrument agency work at a different scale and for a different purpose. The results will reveal if the findings of section 5.2 hold true for different industries.

## 5.2. Estimation results of static and dynamic panel data models

The analysis starts by estimating a selection equation to deal with potential self-selection. The first column in Table 4 contains the outcome of the applied probit model. As noted before, these estimates are used to calculate the inverse mills ratio, which is then included as an additional control variable in all subsequent estimations to take into account the selection problem. The actual analysis of the relationship between ULC and the use of temporary agency work begins with an OLS model followed by a fixed effects model. The results of these estimates are given in column two and three. Column four presents the system GMM model treating all explanatory variables as exogeneous. In contrast, both share variables and the variable export intensity are treated as predetermined in the system GMM model in column five. Both share variables are treated this way in order to check whether previous results are driven by poten-

[12] Following Roodman (2009), we reduce the number of instruments by collapsing them because too many instruments could lead to a bias in estimates. Without collapsing, the number of instruments increases by 2.5 times from 65 to 163. This heavily affects the Hansen test of exogeneity of instruments. However, the estimated coefficients are hardly affected. Although the tables are omitted from this paper, the results are available upon request from the authors.

tial endogeneity. The export intensity variable is chosen because of the ongoing discussion whether only productive and competitive companies become exporters or if companies become more productive if facing strong global competition.

<insert Table 4 about here >

Starting with the OLS model, we find a negative and significant coefficient for the variable share and a significant positive coefficient for the squared share variable. Controlling for firm specific fixed effects leads to higher values for both share variables, but the signs and significances are not affected. The same is true for both system GMM estimates. It follows, that an increase of the share variable decreases ULC and, therefore, increases firms' competitiveness. The positive sign of the coefficient of the squared share variable shows on the other hand, that this is not a linear relationship, but that the rising competitiveness turned into a declining one, if the share of temporary agency worker increases too much. Hence, our hypothesis of a non-linear relationship between the ULC and the extent to which temporary agency work is used by the firms is confirmed in all models.

With respect to the control variables, the following is found: The coefficient for firm size is positive in all models, but not significant in the OLS model, which indicates that unit labor costs increases with firm size. The coefficient of the variable number of products is always positive. Again, unit labor cost seems to increase when the product range increases. However, the coefficient is significant only in the OLS model and in the first GMM model. For the variable average labor costs we find a negative and significant coefficient in the OLS model, while in the fixed effects model the coefficient is positive and significant. Hence, the coefficient in the OLS model seems to be affected by a fixed effects bias. In both GMM models the coefficient is positive, but not significant. Finally, the variables external, capital intensity, intermediate intensity and export intensity have negative and significant coefficients in all models. Thus, it follows, that (1) firms focusing on core activities by outsourcing activities like repairing machines will increase their competitiveness; (2) the more capital intensive the production process, the lower the unit labor costs; (3) the higher a company is located in the production chain, measured by the proxy intermediate input, the more competitive the firm is; and (4) the more a company sells its products on the global market, the lower the unit labor costs and hence the greater the firm competitiveness. Interestingly, this holds true even if we treat this variable as non-exogenous but predetermined. Additionally, the coefficient of the inverse mills ratio is negative and significant in the OLS model as well as in the fixed effects model, while it is not significant in either GMM model. Therefore, controlling for the selection effect seems to be necessary, at least in the pooled and in the static panel model.

With respect to the estimation quality note that, on the one hand, the test for autocorrelation of the error terms in levels in all system GMM specifications performs well. On the other hand, the null hypothesis of the Hansen test of over-identifying restrictions is rejected for both system GMM estimations. This could be driven by the high number of observations, while the number of observations by firms is, on average, only 3.7. So far, however, results of the sys-

tem GMM models should be cautiously interpreted and we regard the fixed effect regression as the preferred model.

To sum up, the results of all models reported in Table 4 support our hypothesis of a nonlinear, U-shaped relationship between the competiveness and the extent that temporary agency workers are used by firms. Finally, given the coefficients for the share variable and its squared form, we can calculate an optimal share of temporary agency workers *ceteris paribus*. However, one should be careful interpreting the results, because the measure for the intensity of using temporary agency workers is calculated as the shares of temporary agency work on total spending for labor. Then, the optimal share, based on the results of the OLS model, is about 17 percent. As discussed before, OLS is affected by a fixed effects bias. When controlling for firm specific effects by running a fixed effects regression, the optimal share is about 11 percent. Both system GMM models, on the other hand, would suggest an optimal share of about 15 percent. However, it must be noted that these estimates follow the rejection of the Hansen test and should be treated with caution.

## 5.3. Robustness checks

For an initial robustness check of the results we estimate the same models as in Table 4, except for the OLS model, without taking into account the selection problem. In the second step, these models are also applied to the subset of firms that actually used temporary agency work at least once during the observation period. The results of all estimates in Table 5 confirm our previous findings. Regardless of the method applied or the sample used, we find a negative and significant coefficient for the variable share and a significant positive coefficient for the squared share variable. Additionally, the control variables keep their sign and are mostly significant. With respect to the quality of the GMM estimations, we have to note that the null hypothesis of the Hansen test is again rejected when the models are applied on the entire data set without controlling for the selection effect. Interestingly, however, when applying the same models on the subset of firms that actually used temporary agency work at least once, the null hypothesis of the Hansen test cannot be rejected. Hence, these results are reliable.

Thus, two things can be stated. First, all estimates support our main finding of a U-shaped relationship between the extent of using temporary agency work and competiveness. Second, when calculating the optimal shares, we find it to be between 10.4 percent and 11.9 percent in all fixed effect models and the GMM estimations where the null hypothesis of the Hansen test could not be rejected.

<insert Table 5 and Table 6 about here >

For a final robustness check, we estimate separate models for research-intensive and non-research-intensive firms. The assignment of the companies is based upon their assignment to research-intensive and non-research-intensive industries by the Expert Commission on Re-

search and Innovation (EFI) of the German Federal Government.[13] For each group we estimate a fixed effects model and two system GMM models with the same specifications as before. The results are shown in Table 6.

For both sub samples we find the U-shaped relationship between the use of temporary agency work and ULC in all models. In the fixed effects model both share variables are highly significant, while in the dynamic panel data models some are only significant at a ten percent significance level. The test for autocorrelation of the error terms in levels in all system GMM specifications performs well. In both system GMM models that treat all explanatory variables as exogenous, except the lagged dependent variable, the null hypothesis of the Hansen test could not be rejected. The same is true for the models treating both share variables and export intensity as predetermined at the five percent level.

Hence, our estimation results confirm the hypothesis of a U-shaped relationship between the intensity of using temporary agency workers and firm´s competitiveness. This result is robust regardless of whether we account for the selection effect and the potential endogeneity of regressors or not. Moreover, we find the U-shaped relationship in different sub samples.

## 6. Conclusion

In this study the relationship between firm's competitiveness, measured here as unit labor costs (ULC), and the intensity of using temporary agency workers is investigated. From the literature, we identify three main effects of the utilization temporary agency work on the competitiveness of companies. First, it is the increased flexibility in adjusting labor input to changes in demand that comes as a result of using temporary agency workers. This effect is always positive, no matter how high the share of temporary work on the input factor labor is. The second effect is the screening and motivation. Here, we find arguments that if temporary agency work is used to screen for new permanent employees it has a positive effect on the motivation and work performance of both, temporary agency workers and permanent employees. This, however, changes if the share is too high and firms follow a strategy of substituting permanent staff by temporary agency workers. Finally, the temporary agency worker lack firm specific human capital. In this regard, temporary work has always a negative impact on the competitiveness of firms. Because of these opposing effects, we expect to find a U-shaped relationship between the share of temporary agency work on total labor force and competitiveness of firms, measured by unit labor costs.

We test our hypothesis of a nonlinear dependency by regressing ULC on a proxy for the share of temporary agency work on total employment and the quadratic share as well as several controls. We control for firm specific effects by applying fixed effects regression models. To control for a potential selection into the use of this form of employment, we initially apply a selection equation and secondly restricting the sample to firms that actually used of temporary agency work at least once. Moreover, we control for potential endogeneity of independent variables and dynamic effects by using system GMM models.

[13] For more information on the Commission see http://www.e-fi.de/index.php?id=1&L=1. The classification follows the NIW/ISI list 2006. See also Legler and Frietsch (2007).

We find a U-shaped relationship between the intensity of temporary agency work used and the competitiveness of firms. The results are stable regardless of the applied specification or estimation method. It follows, that an increase in the share of temporary agency worker decreases ULC and, therefore, increases firms' competitiveness. This relationship, however, is not linear. The rising competitiveness turns into a declining one if the share of temporary agency worker increases too much. This nonlinear relationship allows us to calculate the optimal share of temporary agency work for different models. In our preferred model, which is the fixed effects model including the inverse mills ratio to control for the selection bias, the estimated optimal share is about 11 percent. This result is confirmed by various robustness checks.

However, the optimal shares should be interpreted carefully because the share of temporary agency workers in a firm is calculated using monetary information. Thus, the optimal share cannot be interpreted as a share in the number of employees. Nevertheless, our results show that a corporate strategy, which aims to replace permanent staff with temporary workers, will not lead to greater competitiveness. Hence, the fears that permanent staff will be significantly replaced with temporary agency workers seem unfounded because this strategy is not in the company's own interest.

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**Table 1:** Effect of temporary agency work on competitiveness via three main mechanisms

| | Flexibility | Screening/Motivation | Human capital |
|---|---|---|---|
| low share of temporary agency workers | + | + | - |
| high share of temporary agency workers | + | - | - |

**Table 2:** Descriptive Statistics

| Variable | | Mean | Std. Dev. | Observations | |
|---|---|---|---|---|---|
| ULC | overall | 0.3108739 | 0.1376865 | N = | 81525 |
| | between | | 0.1316249 | n = | 17184 |
| | within | | 0.0406212 | T-bar = | 4.74424 |
| Share | overall | 0.0200265 | 0.0473931 | N = | 81525 |
| | between | | 0.0418334 | n = | 17184 |
| | within | | 0.0230968 | T-bar = | 4.74424 |
| Size | overall | 294.664 | 2344.018 | N = | 81525 |
| | between | | 1980.431 | n = | 17184 |
| | within | | 153.1348 | T-bar = | 4.74424 |
| NoProducts | overall | 3.874063 | 8.713.134 | N = | 81525 |
| | between | | 7.882.053 | n = | 17184 |
| | within | | 1.416.631 | T-bar = | 4.74424 |
| AvageLaborCosts | overall | 37327.13 | 12614.97 | N = | 81525 |
| | between | | 11976.5 | n = | 17184 |
| | within | | 3678.347 | T-bar = | 4.74424 |
| External | overall | 0.0525377 | 0.0666286 | N = | 81525 |
| | between | | 0.0614982 | n = | 17184 |
| | within | | 0.0272645 | T-bar = | 4.74424 |
| CapitalIntensity | overall | 94763 | 136060.2 | N = | 81525 |
| | between | | 123908.4 | n = | 17184 |
| | within | | 45542.73 | T-bar = | 4.74424 |
| IntermediateIntensity | overall | 0.4127073 | 0.2000609 | N = | 81525 |
| | between | | 0.1763552 | n = | 17184 |
| | within | | 0.0906634 | T-bar = | 4.74424 |
| ExportIntensity | overall | 0.234095 | 0.2518343 | N = | 81525 |
| | between | | 0.2413031 | n = | 17184 |
| | within | | 0.054967 | T-bar = | 4.74424 |
| EstablishmentProfile1 | overall | 0.8556148 | 0.351482 | N = | 81525 |
| | between | | 0.3349743 | n = | 17184 |
| | within | | 0.0055535 | T-bar = | 4.74424 |
| EstablishmentProfile2 | overall | 0.0481693 | 0.2141251 | N = | 81525 |
| | between | | 0.2064129 | n = | 17184 |
| | within | | 0.0411076 | T-bar = | 4.74424 |
| EstablishmentProfile3 | overall | 0.0962159 | 0.2948889 | N = | 81525 |
| | between | | 0.2732703 | n = | 17184 |
| | within | | 0.0409709 | T-bar = | 4.74424 |
| LegalForm1 | overall | 0.3752469 | 0.4841896 | N = | 81525 |
| | between | | 0.4738795 | n = | 17184 |
| | within | | 0.1031347 | T-bar = | 4.74424 |
| LegalForm2 | overall | 0.6209138 | 0.4851626 | N = | 81525 |
| | between | | 0.4751446 | n = | 17184 |
| | within | | 0.101419 | T-bar = | 4.74424 |
| LegalForm3 | overall | 0.0038393 | 0.0618435 | N = | 81525 |
| | between | | 0.0558238 | n = | 17184 |
| | within | | 0.0220029 | T-bar = | 4.74424 |

**Table 3:** Share per industry[14]

| Industry | WZ | mean | p1 | p99 | sd | N |
|---|---|---|---|---|---|---|
| Manufacture of food products and beverages | 15 | 0,02045 | 0 | 0,27113 | 0,05650 | 9,607 |
| Manufacture of tobacco products | 16 | 0,02771 | | | 0,05132 | 67 |
| Manufacture of textiles | 17 | 0,00708 | 0 | 0,10270 | 0,02526 | 3,075 |
| Manufacture of wearing apparel; dressing and dyeing of fur | 18 | 0,00192 | 0 | 0,04938 | 0,01117 | 770 |
| Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear | 19 | 0,01123 | | | 0,03252 | 649 |
| Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials | 20 | 0,01517 | 0 | 0,16468 | 0,03332 | 2,093 |
| Manufacture of paper and paper products | 21 | 0,01049 | 0 | 0,11309 | 0,02135 | 2,414 |
| Publishing, printing and reproduction of recorded media | 22 | 0,00746 | 0 | 0,14376 | 0,03113 | 4,912 |
| Manufacture of coke, refined petroleum products and nuclear fuel | 23 | 0,00883 | | | 0,01623 | 180 |
| Manufacture of chemicals and chemical products | 24 | 0,01567 | 0 | 0,14599 | 0,03245 | 5,063 |
| Manufacture of rubber and plastics products | 25 | 0,01982 | 0 | 0,17292 | 0,03762 | 4,849 |
| Manufacture of other non-metallic mineral products | 26 | 0,01600 | 0 | 0,17285 | 0,04216 | 4,078 |
| Manufacture of basic metals | 27 | 0,02179 | 0 | 0,19745 | 0,04121 | 3,381 |
| Manufacture of fabricated metal products, except machinery and equipment | 28 | 0,02985 | 0 | 0,31821 | 0,06259 | 9,532 |
| Manufacture of machinery and equipment n.e.c. | 29 | 0,02348 | 0 | 0,22711 | 0,04850 | 12,830 |
| Manufacture of office, accounting and computing machinery | 30 | 0,02224 | 0 | 0,29187 | 0,05753 | 688 |
| Manufacture of electrical machinery and apparatus n.e.c. | 31 | 0,02145 | 0 | 0,24217 | 0,04588 | 4,516 |
| Manufacture of radio, television and communication equipment and apparatus | 32 | 0,01990 | 0 | 0,21354 | 0,04292 | 1,394 |
| Manufacture of medical, precision and optical instruments, watches and clocks | 33 | 0,01274 | 0 | 0,16828 | 0,03603 | 3,097 |
| Manufacture of motor vehicles, trailers and semi-trailers | 34 | 0,03597 | 0 | 0,29329 | 0,06286 | 3,102 |
| Manufacture of other transport equipment | 35 | 0,04690 | 0 | 0,35007 | 0,07542 | 1,334 |
| Manufacture of furniture; manufacturing n.e.c. | 36 | 0,01410 | 0 | 0,16418 | 0,03659 | 3,894 |

[14] Due to private policy of the Research Data Centers, some percentiles are not publishable due to the small number of cases in the respective subgroups.

**Table 4:** Estimation results of static and dynamic panel data models with controlling for the selection effect via the inverse mills ratio

| Variables | Probit | OLS | Fixed Effect | System GMM / all exogenous | System GMM / predetermined |
|---|---|---|---|---|---|
| Endogenous variable | Dummy for temporary agency work | ULC | ULC | ULC | ULC |
| Lag one of ULC | | | | 0.519*** | 0.501*** |
| | | | | (0.0229) | (0.0226) |
| Share | | -0.0964*** | -0.113*** | -0.116*** | -0.147*** |
| | | (0.0127) | (0.0149) | (0.0216) | (0.0262) |
| Share2 | | 0.609*** | 1.085*** | 0.838*** | 1.082*** |
| | | (0.109) | (0.116) | (0.166) | (0.231) |
| Size | 0.292*** | 9.76e-05 | 0.0232*** | 0.0141*** | 0.00892** |
| | (0.00577) | (0.000318) | (0.00211) | (0.00474) | (0.00416) |
| NoProducts | -0.0351*** | 0.00554*** | 0.000209 | 0.0105** | 0.00585 |
| | (0.00650) | (0.000328) | (0.000925) | (0.00420) | (0.00381) |
| AvageLaborCosts | 0.703*** | -0.00591*** | 0.0611*** | 0.00394 | 0.00667 |
| | (0.0160) | (0.000990) | (0.00236) | (0.00663) | (0.00427) |
| External | 1.195*** | -0.332*** | -0.149*** | -0.186*** | -0.181*** |
| | (0.0920) | (0.00675) | (0.0104) | (0.0108) | (0.0103) |
| CapitalIntensity | 0.0171*** | -0.0191*** | -0.00546*** | -0.00995*** | -0.00993*** |
| | (0.00481) | (0.000310) | (0.000535) | (0.000574) | (0.000566) |
| IntermediateIntensity | 0.206*** | -0.0933*** | -0.0333*** | -0.0475*** | -0.0464*** |
| | (0.00940) | (0.000936) | (0.00182) | (0.00225) | (0.00206) |
| ExportIntensity | 0.111*** | -0.0489*** | -0.0482*** | -0.0418*** | -0.0675*** |
| | (0.0292) | (0.00159) | (0.00541) | (0.00562) | (0.00909) |
| InversMillsRatio | | -0.00758*** | -0.0656*** | -0.0403 | 0.00190 |
| | | (0.00267) | (0.00545) | (0.0245) | (0.0122) |
| EstablishmentProfile2 | -0.142*** | 0.0111*** | 0.0501*** | -0.156** | -0.182** |
| | (0.0227) | (0.00119) | (0.00679) | (0.0785) | (0.0719) |
| EstablishmentProfile3 | 0.0552*** | -0.00644*** | 0.0513*** | -0.0948 | -0.0338 |
| | (0.0186) | (0.000931) | (0.00723) | (0.0720) | (0.0615) |
| LegalForm2 | 0.0135 | | | | |
| | (0.00983) | | | | |
| LegalForm3 | -0.341*** | | | | |
| | (0.0784) | | | | |
| Year Dummies | yes | yes | yes | yes | yes |
| Industry Dummies | yes | yes | yes | yes | yes |
| Constant | -9.021*** | 0.426*** | -0.330*** | 0.151 | 0.0872 |
| | (0.156) | (0.0110) | (0.0318) | (0.120) | (0.0708) |
| Observations | 81,525 | 81,525 | 81,525 | 63,789 | 63,789 |
| R-squared/ Pseudo R-squared | 0.1424 | 0.526 | 0.194 | | |
| Number of ID | | | 17,184 | 17,184 | 17,184 |
| Wald chi2 | | | | 28,070.71 | 27,019.22 |
| No. of instruments | | | | 44 | 65 |
| Hansen test p-value | | | | 0.002 | <0.001 |
| p-value of Arellano-Bond test for AR(2) in first differences | | | | 0.287 | 0.398 |
| Optimal Share | | 17,15% | 10,98% | 14.85% | 14.55% |

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

**Table 5:** Estimation results using static and dynamic panel data models with and without controlling for the selection effect via a dummy variable for the use of temporary agency work

| Variables | Fixed Effect† | System GMM / all exogenous† | System GMM / predetermined† | Fixed Effect‡ | System GMM / all exogenous‡ | System GMM / predetermined‡ |
|---|---|---|---|---|---|---|
| Endogenous variable | ULC | ULC | ULC | ULC | ULC | ULC |
| Lag one of ULC | | 0.525*** | 0.501*** | | 0.513*** | 0.488*** |
| | | (0.0231) | (0.0226) | | (0.0275) | (0.0313) |
| Share | -0.120*** | -0.102*** | -0.147*** | -0.101*** | -0.0719*** | -0.121*** |
| | (0.0151) | (0.0201) | (0.0259) | (0.0148) | (0.0184) | (0.0316) |
| Share2 | 1.101*** | 0.792*** | 1.084*** | 1.021*** | 0.662*** | 1.077*** |
| | (0.116) | (0.165) | (0.230) | (0.112) | (0.149) | (0.275) |
| Size | 0.0224*** | 0.0141*** | 0.00915** | 0.0185*** | 0.00965* | 0,00603 |
| | (0.00212) | (0.00471) | (0.00398) | (0.00258) | (0.00511) | (0.00499) |
| NoProducts | 0.000233 | 0.0121*** | 0.00596 | 0.000540 | 0.0102** | 0,00406 |
| | (0.000943) | (0.00399) | (0.00380) | (0.00111) | (0.00464) | (0.00510) |
| AvageLaborCosts | 0.0657*** | 0.0113** | 0.00645 | 0.0662*** | 0.0201*** | 0.0156*** |
| | (0.00229) | (0.00466) | (0.00396) | (0.00291) | (0.00545) | (0.00478) |
| External | -0.146*** | -0.183*** | -0.182*** | -0.150*** | -0.149*** | -0.143*** |
| | (0.0104) | (0.0107) | (0.0103) | (0.0139) | (0.0135) | (0.0155) |
| CapitalIntensity | -0.00566*** | -0.00973*** | -0.00994*** | -0.00555*** | -0.00918*** | -0.00888*** |
| | (0.000536) | (0.000572) | (0.000570) | (0.000670) | (0.000653) | (0.000873) |
| IntermediateIntensity | -0.0322*** | -0.0456*** | -0.0465*** | -0.0403*** | -0.0497*** | -0.0514*** |
| | (0.00188) | (0.00206) | (0.00203) | (0.00270) | (0.00270) | (0.00305) |
| ExportIntensity | -0.0514*** | -0.0453*** | -0.0676*** | -0.0461*** | -0.0398*** | -0.0715*** |
| | (0.00546) | (0.00502) | (0.00906) | (0.00629) | (0.00615) | (0.0142) |
| EstablishmentProfile2 | 0.0535*** | -0.0916 | -0.185*** | 0.0574*** | -0,0788 | -0.312** |
| | (0.00698) | (0.0672) | (0.0677) | (0.00789) | (0.121) | (0.136) |
| EstablishmentProfile3 | 0.0515*** | -0.137** | -0.0344 | 0.0549*** | -0,0894 | 0,0271 |
| | (0.00741) | (0.0648) | (0.0617) | (0.00839) | (0.0711) | (0.0757) |
| Year Dummies | yes | yes | yes | yes | yes | yes |
| Industry Dummies | yes | yes | yes | yes | yes | yes |
| Constant | -0.477*** | 0.000821 | 0.0919 | -0.486*** | -0,0916 | -0,00917 |
| | (0.0302) | (0.0732) | (0.0630) | (0.0383) | (0.0835) | (0.0740) |
| Observations | 81,525 | 63,789 | 63,789 | 54,315 | 42,843 | 42,843 |
| Number of ID | 17,184 | 17,184 | 17,184 | 11,046 | 11,046 | 11,046 |
| R-squared/ Pseudo R-squared | 0.188 | | | 0.218 | | |
| Wald chi2 | | 27,712.70 | 26,717.40 | | 26,079.96 | 12,227.29 |
| No. of instruments | | 44 | 65 | | 44 | 65 |
| Hansen test p-value | | 0.002 | <0.010 | | 0,151 | 0.078 |
| p-value of Arellano-Bond test for AR(2) in first differences | | 0.227 | 0.402 | | 0.252 | 0.911 |
| Optimal Share | 11.52% | 13.74% | 14.52% | 10.40% | 11.47% | 11.89% |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

† Model without selection control, ‡ Model with selection control via subsampling

**Table 6:** Estimation results for the subset of research-intensive and non-research-intensive industries using static and dynamic panel data models and controlling for the selection effect via a dummy variable for the use of temporary agency work

| | research-intensive industries | | | non-research-intensive industries | | |
|---|---|---|---|---|---|---|
| | fixed effect | system GMM† | system GMM‡ | fixed effect | system GMM† | system GMM‡ |
| Lag one of ULC | | 0.473*** | 0.469*** | | 0.527*** | 0.504*** |
| | | (0.0470) | (0.0327) | | (0.0519) | (0.0479) |
| Share | -0.140*** | -0.0869** | -0.192*** | -0.0639*** | -0.0425* | -0.0549* |
| | (0.0251) | (0.0400) | (0.0483) | (0.0184) | (0.0225) | (0.0316) |
| Share2 | 1.076*** | 0.581* | 1.369*** | 0.935*** | 0.519*** | 0.738*** |
| | (0.218) | (0.298) | (0.435) | (0.126) | (0.189) | (0.266) |
| Size | 0.0132*** | 0.00681 | 0.00478 | 0.0234*** | 0.00671 | 0.00724 |
| | (0.00407) | (0.00894) | (0.00703) | (0.00317) | (0.00609) | (0.00443) |
| No. of products | -0.000122 | 0.0112 | 0.00659 | 0.00154 | 0.00671 | 0.00519 |
| | (0.00172) | (0.00811) | (0.00695) | (0.00142) | (0.00594) | (0.00507) |
| Average labor costs | 0.0759*** | 0.0381*** | 0.0363*** | 0.0618*** | 0.00891 | 0.00937** |
| | (0.00437) | (0.00992) | (0.00646) | (0.00360) | (0.00655) | (0.00436) |
| External | -0.173*** | -0.122*** | -0.122*** | -0.125*** | -0.158*** | -0.161*** |
| | (0.0251) | (0.0205) | (0.0177) | (0.0144) | (0.0151) | (0.0147) |
| Capital Intensity | -0.00504*** | -0.00782*** | -0.00846*** | -0.00576*** | -0.00939*** | -0.00921*** |
| | (0.00120) | (0.00125) | (0.00104) | (0.000767) | (0.000888) | (0.000981) |
| Intermediate intensity | -0.0478*** | -0.0519*** | -0.0521*** | -0.0321*** | -0.0480*** | -0.0492*** |
| | (0.00365) | (0.00355) | (0.00310) | (0.00358) | (0.00491) | (0.00455) |
| Export intensity | -0.0513*** | -0.0475*** | -0.0663*** | -0.0382*** | -0.0301*** | -0.0616*** |
| | (0.00906) | (0.0102) | (0.0127) | (0.00760) | (0.00701) | (0.0187) |
| Establishment profile 2 | 0.0690*** | 0.141 | -0.0793 | 0.0429*** | -0.0807 | -0.122 |
| | (0.00912) | (0.349) | (0.220) | (0.0150) | (0.0969) | (0.0860) |
| Establishment profile 3 | 0.0578*** | -0.133 | -0.0568 | 0.0490*** | -0.0371 | -0.0141 |
| | (0.00307) | (0.127) | (0.107) | (0.0160) | (0.0762) | (0.0619) |
| Year Dummies | yes | yes | yes | yes | yes | yes |
| Industry Dummies | yes | yes | yes | yes | yes | yes |
| Constant | -0.598*** | -0.265* | -0.220** | -0.453*** | 0.0695 | 0.0727 |
| | (0.0602) | (0.139) | (0.101) | (0.0472) | (0.102) | (0.0700) |
| Observations | 23,633 | 18,655 | 18,655 | 30,682 | 24,188 | 24,188 |
| R-squared | 0.204 | | | 0.242 | | |
| Number of ID | 4,860 | 4,840 | 4,840 | 6,367 | 6,342 | 6,342 |
| No. of instruments | | 30 | 51 | | 36 | 57 |
| Hansen test p-value | | 0.412 | 0.373 | | 0.393 | 0.058 |
| p-value of Arellano-Bond test for AR(2) in first differences | | 0.805 | 0.319 | | 0.664 | 0.701 |
| Optimal share | 13.8% | 16.1% | 15.1% | 7.1% | 8.5% | 7.7% |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

† all variables treated as exogenous, ‡ all variables treated as predetermined