# Labor Demand and Unequal Payment: Does Wage Inequality matter?

## Analyzing the Influence of Intra-firm Wage Dispersion on Labor Demand with German Employer-Employee Data

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# Abstract*

## Labor Demand and Unequal Payment: Does Wage Inequality matter?

### Analyzing the Influence of Intra-firm Wage Dispersion on Labor Demand with German Employer-Employee Data

This paper examines the relationship between intra-firm wage dispersion and establishments' employment in a theoretical analysis and empirical regressions using German "Linked Employer-Employee Data from the IAB" (LIAB) for the years of 1996 through 2008. Therefore, fractional probit models for the panel data, recommended in Papke and Wooldridge (2008), and fixed effects regression with a log-odds transformation of the dependent variable are conducted to estimate share equations of a labor demand model.

The results illustrate a negative influence of the residual wage inequality that takes into account the composition of the workforce in the establishment with employment. In addition, an increasing wage dispersion at the lower end of the wage distribution decreases labor demand of the establishment but the estimates of the overall wage dispersion becomes insignificant then.



* This study uses the linked employer-employee panel data of the Institute for Employment Research LIAB, Waves 1996 to 2008. Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and/or remote data access.

# Labor Demand and Unequal Payment: Does Wage Inequality matter?

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## 1. Introduction

The role of wage dispersion in the economy is widely discussed in the literature. On one hand, low wage dispersion is often blamed as the reason for the differences in the unemployment levels when comparing the U.S. and continental Europe. Krugman (1994) e.g. states that increasing wage dispersion in the U.S. and increasing unemployment in continental European countries are “different sides of the same coin”. In addition, standard matching models state that a higher wage dispersion would decrease unemployment (Mortensen & Pissarides 2011). As such, union behavior and legal minimum wages compress wages, leading to a lower employment level. On the other hand, intra-firm wage dispersion possibly indicate frictions in the matching process and therefore lower the employment level (Fitzenberger and Garloff 2008). In a different part of the literature, there is concern over whether wage dispersion influences firms’ productivity (Mahy, Rycx & Volral 2011). Studies on this topic use a broad number of empirical approaches and often come to differing results.

In this paper, a new focus is placed on the influence of wage dispersion. The theoretical analysis shows, that frictions in the matching process, depending on predictions of the employer about the workers’ productivity, are one source of a lower labor demand on the establishment level. But these frictions are not always related to a larger wage dispersion. In addition, wage inequality possibly influence the firms’ productivity and thus employment at the establishment level. Empirically, a labor demand model and linked employer-employee data for Germany are used to investigate the link between wage dispersion and employment at the establishment level. Whether or not one can indicate an influence on firms’ employment, the results will provide some insight on the results of the matching models or the studies on productivity.

Estimating the share equation of the labor demand model is typically conducted using the well-known log-odds transformation of the share of labor costs and applying the dependent variable of the theoretical standard labor demand model; in this study, we also use another approach, the fractional panel probit model. This probit model has several advantages over the transformation of shares (Papke & Wooldridge 2008). It takes into account the unobserved heterogeneity among the firms and allows for the estimation of the parameters, when the dependent variable is 0 or 1, respectively, or when the covariates do not vary over time or establishments.

The rest of this paper is organized as follows. Section 2 contains a brief overview of the existing literature. Section 3 introduces the theoretical labor demand model, while Section 4 describes the data. The empirical models are derived and the results of the regression are presented in in Section 5. The paper ends with some conclusions from the empirical outcomes.

## 2. Previous Research

Neoclassical search and matching models are often used to analyze the influence of wage dispersions on employment at the macro-economic level (Mortensen & Pissarides 2011). Other models deal with the productivity of establishments according to the spread of wages within a firm (e.g. Jirjahn & Kraft 2007, Lallemand et al. 2007, Braakmann 2008, Grund & Westergaard-Nielsen 2008, Martins 2008, Hunnes 2009, Mahy, Rycx & Volral 2011). In the study at hand, the goal is to determine whether wage dispersion influences labor demand at the firm level.

Even if firms offer identical jobs and the observed qualifications of the employees are equal, it is possible to derive a labor demand model that reveals a positive wage dispersion within establishments, if the employer has imperfect information about the workers abilities and attitudes in the hiring process. From theory we know that the demand for labor is optimal, when the marginal product of the workers equals its real wage (e.g. Hamermesh 1993):

(1) $Y_L = \frac{w}{p}$, with $Y_L$ as marginal productivity and $\frac{w}{p}$ as real wage.

Among other aspects, this results holds only if the equal observed qualification determines the productivity of workers completely and all employees show the same behavior on the job. Normally, in imperfect labor markets the employers do not know the employees attitudes to work hard and careful before hiring and the observed qualification do not cover all aspects of the workers abilities (e.g. Garibaldi 2005). Possibly, hidden characteristics and hidden action influence the workers marginal product in a positive or a negative direction. This means the marginal product differs from employee to employee and the firms have an incentive to offer different wages according to the individual marginal productivity:

(2) $Y_{Li}(hc, ha) = \frac{w_i}{p}$,

with i as the individual worker and hc and ha as hidden characteristics and hidden action, respectively.

In total the firm works in an optimum, when it pays each worker according to its individual marginal product. Therefore, the average wage should be equal to the average marginal productivity. This leads to the following expression:

(3) $$\frac{\sum Y_{L_i}}{N} = \frac{\sum w_i}{pN}$$

or

(3a) $\overline{Y}_L = \frac{\overline{w}}{p}$, with $\overline{Y}_L$ as average productivity and $\overline{w}$ as average wage.

The effect of the wage dispersion that occurs through imperfect information about the job applicants depend on both, the ability of the employers to predict the unobservable attitudes and abilities of the newly hired workers and the preferences of the employees towards an equal or unequal remuneration. If the firms are able to identify the characteristics and attitudes of a newly hired worker, equation (3) holds and labor demand will reach an optimum. On the other side, equation (3) is violated, when the methods to predict the workers' productivity fail. In this case, some workers receive a wage that is lower than its marginal product and some have a remuneration that is larger than the individual productivity. Employees who are paid less than their marginal product have an incentive to leave the firms, as they are possibly not satisfied with the remuneration and expect higher wages in a new job outside the firm. Employees that receive a wage higher than their marginal product tend to stay in the job for the opposite reasons. In these firms equation (3) alters to:

$$\text{(3b)} \quad \overline{Y}_{L_i} < \frac{\overline{w}_i}{p}$$

The firms should reduce employment to increase marginal productivity and to reach optimal labor demand according to equation (3). In this sense, wage dispersion is a result of frictions in the firms' search process and thus related to lower labor demand and higher unemployment. Fitzenberger and Garloff (2008) state from their analysis of a search model that a larger wage dispersion possibly is a sign for stronger frictions in the search process. This frictional hypothesis goes along with the model in the work at hand, if we assume that larger wage dispersion is associated with a lower ability of the employers to predict the correct productivity of the newly hired workers.

On the other side, in standard matching models the bargaining power of unions is often linked to a stronger wage compression and therefore a higher unemployment in an economy (Mortensen & Pissarides 2011). Stole and Zwiebel (1996) developed the notion that bargaining over the remuneration of employees will lead to the overemployment of some groups with strong bargaining power. As the wages are also related to the workers' productivity, the bargaining power of these groups will be diminished when more employees are hired and the marginal productivity of these employees decreases. Cahuc, Marque and Wasmer (2007) and Mortensen (2010) introduced the ideas of Stole and Zwiebel (1996) to matching models and show that employment possibly increases with the increasing bargaining power of some groups. Both the simple matching models and the model of Stole and Zwiebel (1996) relate a higher wage dispersion to a higher employment level, as the introduction of an unequally distributed bargaining power within a firm would indicate a wage differentiation among the firm's workers. Fitzenberger and Garloff (2008) analyze the influence of wage dispersion on unemployment in the context of neoclassical and matching theories. Their results indicate that wage dispersion within entities does not correlate with the level of unemployment.

One way to overcome the problem of unobservable workers' characteristics is e.g. the introduction of tournament remuneration. If higher wages and promotions are rewarded to the workers with the highest productivity, irrespective of the best performance, the employees should have an incentive to work as hard as possible (Lazear 2000). Wage dispersion implies then a higher productivity of the top performers and is associated with an increase of the overall labor productivity of the firm.

On the other hand, this kind of tournament remuneration may have negative effects on the firms' productivity. Sabotage of the work of other employees (Lazear 1989), unproductive rent-seeking (e.g., approaches to change the wage structure in the own favor by influencing the supervisors) (Milgrom & Roberts 1990) and a diminished intrinsic motivation through monetary rewards (Frey 1997) can decrease or reverse the positive effect of a wage dispersion on labor productivity. In addition, large wage dispersion may violate the workers beliefs about a fair remuneration. If the employees consider a large dispersion as unfair, labor productivity will decrease (Akerlof & Yellen 1990). Actually this discussion is also initiated by the rising ration of executive compensation compared to average workers (Fabbri & Marin 2012).

The empirical evidence on this topic differs from study to study, depending on the type of data, econometric method or region respective industry (Mahy, Rycx and Volral 2011). Subsequently, the effect of an increase on labor productivity on the firms demand for labor is not definite and depends on whether the possible gains in productivity will also lead to a higher demand for the firms' goods or services. Higher productivity enables the firm to produce the same amount of goods or services with less labor input. The labor demand will only increase if the firms' growth, initiated by the higher productivity, is larger than the gains in productivity.

The demand for labor is normally analyzed within a functional framework, like a translog, CES or generalized Leontief cost or production function, to derive labor demand elasticities as a measure of the flexibility and efficiency of the labor market (Hamermesh 1993). None of them directly focus on the effects of wage dispersion.

Addison and Teixeira (2001), Flaig and Rottmann (2001) and Reimers (2001) estimated the wage elasticities for Germany. Values were found to be between -0.4 and -0.6, whereas the calculated output elasticities were between 0.6 and 0.8. This means if the wage doubles, employment decrease by 40 to 60 % but if the demand for produced goods or services doubles, employment increases by 60 to 80%. Other studies that derived labor demand for Germany concentrated on the substitutional or complementary relationship among heterogeneous labor and did not calculate the overall elasticities (Falk & Koebel 2001, 2004; Kölling & Schank 2004, Addison et al. 2008). More recent articles have used this framework to analyze the widely discussed introduction of a legal minimum wage in Germany (Jacobi & Schaffner 2008, Bauer et al. 2009, Freier & Steiner 2010). A summary of the results is found in Müller (2009). A (higher) legal minimum wage not only increases the average wage of the employees, but also decreases the dispersion of the wages. Nevertheless, recent studies only focus on the size of the wages and do not take into account the possible influence of a change in the wage dispersion.

# 3. Model

The focus of this stage of the analysis is on the effect of differing wage dispersions on firms overall labor demand, as such, a labor demand model, with two factors of production, capital and labor, is applied. In the following, it is also assumed that production is heterothetic; this is a more general case than a linear homogenous production function. In a heterothetic production function, output is related to factor prices and depends on the scale of the output.

In particular, the model used here is based on a translog cost function (Hamermesh 1993). Next to the generalized Leontief or CES-functions, this functional form is very common in the literature (Falk & Koebel 2004, Jacobi & Schaffner 2008, Freier & Steiner 2010). Usually, the translog cost function in its heterothetical form is derived from the following general form (Berndt & Khaled 1979):

(4) $C = C(w, r, Y)$, with C as costs, r as interest rate and Y production level of the firm.

From the theoretical discussion, wage dispersion is introduced to the model through its influence on wages w and the level of production Y. I assume that the influence of wage dispersion is expressed by the functions f(wd) and g(wd), with wd as wage dispersion. This leads to the following expression:

(4a) $C = C(f(wd) \cdot w, r, g(wd) \cdot Y) = C(w^*, r, Y^*)$

As such, the translog cost function derived from (4a) is applied in the following analysis:

(5) $\ln C = \ln Y^* + a_0 + a_1 \cdot \ln w^* + (1-a_1) \cdot \ln r + 0.5 \cdot b_1 \cdot \ln w^{*2} + b_2 \cdot \ln w^* \cdot \ln r + 0.5 \cdot b_3 \cdot \ln r^2$

$+ d \cdot \ln Y^* \cdot \ln w^* + (1-d) \cdot \ln Y^* \cdot \ln r$

Where: $a_i$, $b_i$ and d are parameters. LnC, lnY*, lnw* and lnr are the logarithms of C, Y*, w* and r, respectively. Applying Shephard's lemma to labor input and taking the ratio to labor costs yields:

(6) $s = a_1 + b_1 \cdot \ln w^* + b_2 \cdot \ln r + d \cdot \ln Y^*$, where $s = \frac{w \cdot L}{Y}$ (share of labor costs in total revenue).

Equation (6) is equal to:

(6a) $s = a_1 + b_1 \cdot \ln(f(wd) \cdot w) + b_2 \cdot \ln r + d \cdot \ln(g(wd) \cdot Y)$

In the following, I assume that f(wd) and g(wd) are given by the subsequent general equations:

(7) $f(wd) = \alpha \cdot wd^{\beta}$

(8) $f(wd) = \delta \cdot wd^{\gamma}$,

with $\alpha$, $\beta$, $\delta$ and $\gamma$ as parameters. After some simple manipulation equation (6a) changes to:

(6b) $s = m_1 + m_2 \cdot \ln(wd) + b_1 \cdot \ln w + b_2 \cdot \ln r + d \cdot \ln Y$,

with $m_1 = a_1 + b_1 \cdot \ln(\alpha) + d \cdot \ln(\delta)$ and $m_2 = b_1 \cdot \beta + d \cdot \gamma$.

This model is very useful for an empirical analysis, but oversimplifies some aspects of labor demand. The wage bill w·L does not only depend on the number of employees, but also on the formation of a firm's labor force. Therefore, worker characteristics have to be included in the analysis. In addition, it is well-known that the remuneration of the employees differs between firm size, industry and union coverage (Groshen 1991). For these reasons, some additional variables Zj are included (see Section 4). To estimate the effects of changes in wages, interest rates and output on labor demands, the corresponding elasticities are derived from the estimates of Equation (4a). The elasticities of labor demand indicate relative changes in the amount of labor when wages, interest or demands are altered with a specific rate (Hamermesh 1993). Taking into account that s is defined as the share of labor costs in total revenue, the elasticities are easily calculated from the marginal effects of the relevant variables ($b_1$; $b_2$ and d) on s, i.e., $\partial s / \partial \ln w$; $\partial s / \partial \ln Y$, $\partial s / \partial \ln r$ and $\partial s / \partial \ln(wd)$:

(9) $$\eta_{Lw} = \frac{\partial L / L}{\partial w / w} = \frac{b_1}{s} - 1.$$

(10) $$\eta_{Lr} = \frac{\partial L / L}{\partial r / r} = \frac{b_2}{s}.$$

(11) $$\eta_{LY} = \frac{\partial L / L}{\partial Y / Y} = \frac{d}{s} + 1.$$

(12) $$\eta_{Lwd} = \frac{\partial L / L}{\partial wd / wd} = \frac{m_2}{s}$$

$\eta$ are the elasticites of labor with respect to changes in the respective variables. From theory, we expect that $\eta_{Lw}$ will be negative and $\eta_{LY}$ will be positive, because the demand for labor decreases with an increase in the price for labor, but increases when production increases. This implies that $b_1$ should be smaller than s and d should be larger than -s. In addition, when capital is more or less a quasi-fixed asset in the short run, the value of $\eta_{Lr}$ , and therefore, $b_2$ , should both be close to zero.

The significant estimated values of $m_2$ will indicate differences in the labor demand by altering the firms' wage inequality. Either $m_2$ is positive indicating that a higher wage dispersion has a positive influence on labor demand or $m_2$ is negative indicating the opposite effect. In addition, if the compression of wages at the lower or upper bound of the wage distribution also influence the firms labor demand, the skewness as the third central moment of the distribution of wages should be introduced to the model. Additionally, the effect of wage inequality is related to firm size and/or wage level. Therefore, estimations with interaction variables among wd and w respectively Y are also conducted in this analysis.

The labor demand model used here is a static model and does not contain lagged variables, like a dynamic model does, to calculate the adjustment processes. As most of the adjustment processes take place within a year and yearly data is overaggregated, this assumption is reasonable (Hamermesh 1993, 253 pp.). Additionally, the use of lagged dependent variables to model labor demand dynamics is caused by a quadratic adjustment of the cost function. This is very restrictive, and also questionable, as empirical studies with other cost functions, like lumpy or linear costs, illustrate results with at least the same efficiency (Hamermesh 1993). Before this model is tested empirically, the data to be used is described.

# 4. Data

The analysis uses data from the Linked Employer-Employee Data of the IAB[1] (LIAB), which combines individual data from the official labor statistics social security insurance data and the IAB-Establishment Panel survey establishment data (Jacobebbinghaus & Seth 2010)[2].

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[1] IAB: Institute for Employment Research of the Federal Employment Agency in Germany

[2] Data access was provided via remote data access from the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB).

The individual data from different sources is merged with the Integrated Employment Biographies (IEB). The IEB contains information about employment subject to social security (since 1975), marginal employment (since 1999), unemployment (since 1975) and social benefits (from 1975 through 2005 for benefits in accordance with the German Social Code Book II), registered jobseekers (since 2000), and participants in employment or training programs (since 2000). The data covers all employees and trainees subject to social security and excludes some of the civil servants ("Beamte"), self-employed and family workers. As such, over 80% of all employed persons are included in the IEB (Dorner et al. 2010).

The establishment data was obtained from the Institute for Employment Research of the Federal Labor Agency. They began collecting this data in Western Germany 1993, although they didn't collect data for the former eastern part of Germany until 1996. The dataset was created to meet the needs of the Federal Employment Agency for improved information on the demand side of the labor market. It is based on a stratified random sample. The strata are for 16 industries[3], 10 employment-size classes, and 16 regions (the Bundesländer), from the population of all German establishments with at least one employee covered by social insurance. The establishment panel is characterized by very high response rates of over 70% (80% for repeatedly participating establishments). To correct for panel mortality, exits, and newly founded units, the data are augmented and regularly yield an unbalanced panel. Overall, the IAB panel contains actually data for approximately 16,000 establishments each year (Fischer, Janik et al. 2008, 2009).

The LIAB is created by linking the IEB and the IAB-Establishment Panel through a plant identifier available in both datasets. Overall, the LIAB contains 46.182 establishments (from 4.114 to 16.280 per year) and 9.784.880 individuals (from 1.885.684 to 2.586.048 per year). Since Eastern German establishments were added to the IAB-Establishment panel in 1996, the followings analysis uses 13 waves, from 1996 to 2008, for the in-depth investigation.

[3] Currently, 17 industries are used, because of the changes in the system of official statistics.

Descriptive statistics for the principal variables used in this paper are presented in the appendix (see table A.1). The dependent variable is defined as the share of labor costs of total revenue. The LIAB contains information about the firm's turnover in the year prior to the interview and about the daily remuneration and the number of employees. As the wage data comes from social security accounts, the rewards are only reported up to the contribution limit of the German social security system, i.e., the remuneration is censored to that limit. Additionally, the limit changes from year to year and among different occupations e.g. for miners.

To overcome the censoring problem, this analysis follows the suggested procedure of Gartner (2005) and imputes values above the contribution limit with estimated wages from a censored regression. Separate estimations are conducted for each entity in each year. In the regressions, the logarithm of reported wages is used as the dependent variable. Age of the workers and experience in the firm, which are also squared, three different skill levels and the shares of female and foreign employees are used as covariates. Because of the regressions on the establishment level, the following analysis is restricted to entities with 20 or more workers. To avoid a higher correlation between the covariates with the imputed wages than the true remuneration, an error term $\eta$ is added to the projected wages with $\eta \sim N(x'\beta,\sigma^2)$, where the estimated $\sigma$ from the censored estimation is used:

(13) $\ln w_{imp} = x'\beta + \eta$

This measure is obviously related to the employment structure in the establishments. Therefore, following the strategy by Winter-Ebmer and Zweimüller (1999) a variable of wage dispersion is derived from the consored regressions. The standard errors of residuals that take into account determinants of individual wages and thus the residual wage inequality is used in the regressions as a variable.

Using this data, the dependent variable and the measures for the firms wage dispersion are calculated. The dependent variable is defined as the ratio of labor costs and turnover. Labor costs are estimated as the sum of the daily wages. Turnover is divided by 365 to obtain the average daily turnover of an establishment. Daily wages are also computed per calendar day.

Because the turnover is used, establishments that do not report turnover, including banks, insurance companies and public administrations, are excluded from the dataset.

The primary explanatory variables from the theoretical model are the logs of turnover (intermediate materials excluded), wages and costs of capital. In addition, the nominal values of the turnover and wages are discounted by the producer price index. The yearly mean of the 12 month Euribor is used as an instrument for the cost of capital. The Euribor[4] is the rate at which the Euro interbank term deposits within the Euro Zone are offered by one prime bank to another prime bank. This rate is often used as a reference for the refinancing of commercial banks. Therefore, it is often the basis for the base rates of company loans.

According to the theoretical considerations, additional variables are used in the estimations, including the share of female employees, part-timers, temporary workers that are respectively low skilled and foreign workers. Dummy variables are used to represent the legal form of the establishment, the firm's profitability, whether the establishment is covered by a collective agreement, dummies for the 42 industries and, and finally, for western Germany.

The question of whether the price and the quantity of labor and the output are exogenous depends on the assumption that the labor supply is infinitely elastic (i.e., firms take wages as exogenously given and are able to hire as many employees as they demand to maximize profits). Given that the model is specified correctly, studies with micro data generally should not have problems with the endogeneity of the mentioned variables (Freier & Steiner 2010; Hamermesh 1993, 68pp.). In the context of the German labor market in the observed period with imperfect competition, rigid wages and high unemployment rates during the observation period indicate a substantial excess of labor supply. Hence, the assumption of exogeneity does not seem to be too unrealistic. On the other side, there are severe doubts that wage dispersion is independent from the employment decision of previous periods. At least, the average remuneration in small firms is influenced by changes of its workforce. Therefore, lagged values of wage dispersion and skewness are included in the regressions. Since the survey is

[4] The Fibor was used prior to the Euribor until 1998, http://www.euribor-ebf.eu

conducted yearly, the time lag of the variables is also one year. As discussed before, empirical studies suggest that adjustment processes take place within one year (Hamermesh 1993, 253pp.). As the applied model of Wooldridge (2010) uses the mean values of the time varying regressors to identify unobserved heterogeneity, the use of lagged variables in the case of endogeneity is questionable, as the estimates become asymptotically consistent if the number of available time periods is very large. But as the panel used here contains 13 waves, the effect of a specific observation on the average value should be rather low and asymptotically negligible. Also, the same aspect occursfor fixed effects models (FD) of the model, which are conducted with a log-odd transformation of the dependent variable.

## 5. Estimates

The estimation procedure for equations (6) follows two strategies. The first is the conventional textbook method of a log-odds transformation of the dependent variable for a share equation. The share in the model has values between 0 and 1; as such, the converted response variable covers the interval from $-\infty$ to $\infty$. This allows for a linear estimation of the model. It is also possible to take into account the unobserved establishment effects $c_i$ (Wooldridge 2002). The estimated model then becomes:

$$(14)\quad \ln\left(\frac{s}{1-s}\right)_{it} = m_1 + m_2 \cdot \ln(wd)_{it} + b_1 \cdot \ln(w)_{it} + b_2 \cdot \ln r + d \cdot \ln(Y)_{it}\, b_1 \cdot \ln w_{it} + \beta_j \cdot X_{jit} + e_j \cdot Z_{jit} + c_i + u_{it},$$

where $u_{it}$ is an error term of establishment i at time t. One problem to estimate a fixed effects model of equation (14) is the within transformation, that possibly introduce endogeneity to the model, even if lagged variables are used as instruments. But as 13 waves of panel data are used in this analysis, I will assume that the bias is small and the fixed effects model produce valid estimates. The labor demand elasticities also have to take into account the transformation of the dependent variable and change to:

$$(9a)\quad \eta_{Lw} = \frac{\partial L / L}{\partial w / w} = b_1(1-s) - 1 .$$

(10a) $\eta_{Lr} = \frac{\partial L / L}{\partial r / r} = b_2(1-s)$.

(11a) $\eta_{LY} = \frac{\partial L / L}{\partial Y / Y} = d(1-s)+1$.

(12a) $\eta_{Lwd} = \frac{\partial L / L}{\partial wd / wd} = m_2(1-s)$

The log-odds transformation has the advantage of deriving a linear model from a non-linear share equation with a simple manipulation of the dependent variable. Next to the possible endogeneity problem, some severe problems can occur when this procedure is conducted. Firstly, the shares of zero and one are not defined when a log-odds transformation is conducted. Secondly, it is not possible to estimate variables that are time varying, but do not differ between establishments, like market interest rates. Finally, a linear functional form does not reflect the important non-linearities that are possible.

To overcome these problems, Papke and Wooldridge (2008) proposed a fractional panel probit model that allows for the estimation of average partial effects for fractional response data. In this model, it is possible to use responses at the corners and zero and one for the calculations. In addition, the non-linear models and the estimates of the variables that do not change over time or establishments are feasible. Unlike in their earlier work (Papke & Wooldridge 1996), Papke & Wooldridge (2008) use a normal distribution (e.g., a probit model) that leads to simple estimators in the presence of unobserved heterogeneity. In particular, they assume the following model:

(15) $E(y_{it}|x_{it}, c_i) = \Phi(x_{it}\beta_i + c_i)$,

where $y_{it}$ is the response variable, $0 \le y_{it} \le 1$; t = 1, …, T, $c_i$ are firm specific heterogeneities and $\Phi$ is the standard normal cumulative distribution function (cdf). The partial effects not only depend on the estimated $\beta$'s , but also on the density function $\phi$:

(16) $\frac{\partial E(y_{it}|x_{it}, c_i)}{\partial x_{it}} = \beta_i \phi(x_{it}\beta_i + c_i)$.

As the cdf is a monotonic function, the value of $\beta$ identifies the direction of the partial effect. Unfortunately, because of the unobserved nature of $c_i$, it is not possible to calculate the partial effects from Equation (16). One possibility that can be applied to calculate the partial effects in this model is to average the individual partial effects and model the distribution of $c_i$, given strictly exogenous covariates $x_i$, so that the selection becomes ignorable (Papke & Wooldrigde 2008, 123; 2010). The average partial effects (APE) are given by:

$$(17) \qquad E_c[\beta_i \phi(x_{it}\beta_i + c_i)] = \beta_i E_c[\phi(x_{it}\beta_i + c_i)]$$

These APE depend on $\beta$ and x, but not on c (Papke & Wooldridge 2008, 123). The theoretical model is based on a firm's cost function, where the actual use of the production factors are related to their actual total costs. Therefore, the strict exogeneity of the explanatory variables is assumed in the further discussion. In addition, Wooldridge (2010) assumes that the distribution of the unobserved heterogeneity changes with the number of observations for an establishment within the unbalanced panel. He proposes a linear function of time averages for $E(c_i|w_i)$, where $w_i$ is a vector of all known selection indicators due to the unbalanced characteristics of the panel (Wooldridge 2010):

$$(18) \qquad E(c_i|w_i) = \sum_{r=1}^{T} \psi_r + \bar{x}_i \xi_r ,$$

where r is the number of observations of an establishment in the panel, $\bar{x}_i$ is the average of $x_i$ over time and $\psi$ and $\xi$ are the parameters. The variance in the Wooldridge-model also changes with the number of observations of an establishment r:

$$(19) \qquad Var(c_i|x_i) = \exp\left(\tau + \sum_{r=1}^{T-1} \omega_r\right),$$

where $\tau$ is the variance of the base group and $\omega_r$ indicates the deviation of each subgroup from $\tau$. Placing Equations (18) and (19) into Equation (15) yields:

$$(20)\qquad E(y_{it}|x_{it},w_i)=\Phi\left[\frac{x_{it}\beta_i+\sum_{r=2}^{T}(\psi_r+\bar{x}_i\xi_r)}{\left\{1+\exp\left(\tau+\sum_{r=1}^{T-1}\omega_r\right)\right\}}\right].$$

A convenient reparameterization leads to (Wooldridge 2010):

$$(21)\qquad E(y_{it}|x_{it},w_i)=\Phi\left[\frac{x_{it}\beta_i+\sum_{r=2}^{T}(\psi_r+\bar{x}_i\xi_r)}{\exp\left(\sum_{r=2}^{T-1}\omega_r\right)}\right].$$

Variables do not vary across I (e.g., time dummies are omitted from the $\bar{x}_i$) (Wooldridge 2002). Additionally, if no perfect relationship between $x_i$ and some time variation in the elements of $x_i$ is observed, to avoid collinearity with the $\bar{x}_i$, it is possible to identify the scaled parameters $\psi_a$, $\beta_a$ and $\xi_a$. The APE is now calculated by differentiating the expected value of Equation (21) with respect to $x_i$. Applying the law of large numbers, the expected value of Equation (21), or the average structural function ASF, is consistently calculated by Wooldridge (2002; 2010):

$$(22)\qquad ASF(x_i)=N^{-1}\sum_{i=1}^{N}\Phi\left[\frac{x_{it}\hat{\beta}_i+\sum_{r=2}^{T}(\hat{\psi}_r+\bar{x}_i\hat{\xi}_r)}{\exp\left(\sum_{r=2}^{T-1}\hat{\omega}_r\right)}\right]$$

The APE's are then given by the derivative of Equation (22) with respect to $x_i$:

$$(23)\qquad APE(x_i)=\hat{\beta}_i N^{-1}\sum_{i=1}^{N}\phi\left[\frac{x_{it}\hat{\beta}_i+\sum_{r=2}^{T}(\hat{\psi}_r+\bar{x}_i\hat{\xi}_r)}{\exp\left(\sum_{r=2}^{T-1}\hat{\omega}_r\right)}\right]$$

In the current paper, the focus is not on the calculation of the APE's, but on the determination of the factor and output elasticities. Therefore, the average elasticities are derived from the APE's by using the expected means of the cdf in Equation (22). According to Equations (9) to

(12), the average elasticities for the estimated parameters of lnw, lny and ln(Euribor) are as follows:

(9b) $$\eta_{Lw} = \frac{APE(\ln w_i)}{ASF(x_i)} - 1$$

(10b) $$\eta_{Lr} = \frac{APE(\ln r_i)}{ASF(x_i)}$$

(11b) $$\eta_{LY} = \frac{APE(\ln Y_i)}{ASF(x_i)} + 1$$

(12b) $$\eta_{Lwd} = \frac{APE(\ln wd_i)}{ASF(x_i)}$$

From Equations (9b) through (12b), it can be seen that the elasticities vary across firms, but because the propensity density function (pdf) $\phi(.)$ and the cumulated density function (cdf) $\Phi(.)$ also contain the unobserved $c_i$, it is not possible to calculate the individual elasticities from the empirical results.

Table 1 illustrates some basic characteristics of the wage data at establishment level to provide some initial evidence on intra-establishment wage inequality. The development of the intra-firm wage rate in column (1) indicate that there has been a decrease of about 30 log points over the 1996-2008 interval in the data. This figure is in line with the analysis by Card, Heining, and Kline (2013), using information from the IEB datafile for 1995-2009, there has been a decrease of about 5 log points in the daily wage of the whole population/sample of full-time workers aged 20-60 in western Germany. Due to the overrepresentation of large establishments in the IAB establishment survey Wages are therefore demonstrably higher in LIAB database. When the analysis is restricted to western German establishments, as in Addison, Kölling, Texeira (2014), average intra-firm wages decrease over the observed period by approximately 25 log points. Therefore, the overall result in the work at hand is driven by an increase of average establishment wages in eastern German firms, which are also overrepresented in the LIAB datafile. In total, all measures of wage inequality (column 3; 4; 6

to 8) increase over the observed time period from 1996 to 2008. Between 1996 and 2000 the average standard deviation of intra-firm wages increases by 7.4 percent. Although, in the beginning of the millennium after the crash of the new economy wage dispersion temporarily decreased. From 2002 wage dispersion increases again and becomes larger than before. Over the whole period, the standard deviation of intra-firm wages increases by 8.7 percent. This pattern is also observed for the intra-firm residual wage inequality in column (8), but the overall increase of residual wage dispersion quite smaller (5.1%). Mean residual wage dispersion is about 0.199 on average with a standard deviateon of 0.105. Comparing the figures with the results of Winter-Ebmer and Zweimüller (1999), only small differences occur. They estimated standard errors of Tobit regressions with data of 130 firms from records of the Austrian social security for the years 1975-1991, with a mean of 0.205 and a standard deviation of 0.074. Similar patterns occur for the other measures of wage inequality, the coefficient of variation and the 90-10 and the 50-10 wage gap.

The results for the firms' skewness of the wage distribution is always negative, meaning that the distribution of wages is skewed on the left side and the mean of wages is less than (to the left of) the median. The majority of the intra-firm wages is concentrated on the right side of the mean. From 1996 to 2002 the values become more negative and therefore the number of intra-firm wages at the lower tail of the distribution relatively decrease. From the growing unemployment figures of the time period, it is possible to assume that the number of workers with a low remuneration in the establishments had also decreased in absolute numbers. From 2003 the skewness becomes smaller in absolute figures. This could indicate that the portion of workers with small wages in the firms increase and is in line with the reform of the German labor market during this time period.

**Table 1: Summary Statistics and Residual Inequality for the LIAB Sample of Full-Time Workers in Establishments with at least 20 Employees, 1996-2008**

| Year | Mean (number of workers) (1) | Mean of log. establishment daily wage (s.d.) (2) | Intra-establishment wage inequality | | | | | Intra-establishment residual inequality |
|---|---|---|---|---|---|---|---|---|
| | | | Mean of s.d. of log daily wages (s.d.) (3) | Mean of coefficient of variation (s.d.) (4) | Mean of skewness of wage dispersion (s.d.) (5) | 50th-10th gap (s.d.) (6) | 90th-10th gap (s.d.) (7) | Mean (s.d.) (8) |
| **1996** | 5280 (1974206) | 4.459 (0.301) | 0.247 (0.085) | -4.212 (0.327) | -0.238 (1.606) | 0.437 (0.398) | 0.768 (0.474) | 0.165 (0.066) |
| **1997** | 4584 (1703957) | 4.445 (0.302) | 0.249 (0.088) | -4.196 (0.327) | -0.294 (1.756) | 0.446 (0.416) | 0.779 (0.503) | 0.166 (0.067) |
| **1998** | 4957 (1669093) | 4.469 (0.304) | 0.264 (0.109) | -4.206 (0.337) | -0.444 (2.013) | 0.483 (0.458) | 0.828 (0.545) | 0.176 (0.093) |
| **1999** | 4875 (1491045) | 4.493 (0.321) | 0.292 (0.150) | -4.202 (0.387) | -0.710 (2.016) | 0.478 (0.485) | 0.804 (0.602) | 0.191 (0.104) |
| **2000** | 6852 (1694027) | 4.496 (0.354) | 0.321 (0.199) | -4.175 (0.398) | -0.487 (1.721) | 0.511 (0.504) | 0.843 (0.614) | 0.205 (0.116) |
| **2001** | 7442 (1875050) | 4.448 (0.325) | 0.306 (0.161) | -4.142 (0.408) | -0.810 (1.884) | 0.526 (0.526) | 0.862 (0.633) | 0.200 (0.115) |
| **2002** | 6974 (1742812) | 4.483 (0.326) | 0.301 (0.156) | -4.182 (0.408) | -0.807 (2.004) | 0.530 (0.515) | 0.865 (0.622) | 0.196 (0.113) |
| **2003** | 6703 (1580650) | 4.465 (0.339) | 0.306 (0.151) | -4.158 (0.417) | -0.454 (1.717) | 0.522 (0.514) | 0.872 (0.630) | 0.197 (0.107) |
| **2004** | 6810 (1781536) | 4.448 (0.369) | 0.329 (0.188) | -4.119 (0.444) | -0.283 (1.638) | 0.553 (0.551) | 0.903 (0.666) | 0.210 (0.113) |
| **2005** | 6643 (1733569) | 4.380 (0.369) | 0.328 (0.168) | -4.052 (0.435) | -0.333 (1.733) | 0.528 (0.526) | 0.768 (0.474) | 0.211 (0.116) |
| **2006** | 6484 (1682338) | 4.298 (0.367) | 0.329 (0.162) | -3.969 (0.430) | -0.381 (1.710) | 0.536 (0.534) | 0.779 (0.503) | 0.219 (0.113) |
| **2007** | 6387 (1497332) | 4.249 (0.379) | 0.332 (0.177) | -3.919 (0.438) | -0.343 (1.651) | 0.534 (0.529) | 0.828 (0.545) | 0.214 (0.114) |
| **2008** | 6419 (1584558) | 4.144 (0.380) | 0.334 (0.180) | -3.811 (0.446) | -0.367 (1.693) | 0.541 (0.545) | 0.804 (0.602) | 0.216 (0.120) |
| **total** | **80410 (22010171)** | **4.406 (0.360)** | **0.306 (0.161)** | **-4.100 (0.424)** | **-0.467 (1.793)** | **0.516 (0.511)** | **0.843 (0.614)** | **0.199 (0.109)** |

*Notes*: Gross daily wages are deflated using the producer price index and are expressed in year 2005 values. Wages above the contribution limit to the social security system were imputed using the procedure suggested by Gartner (2005). Both observed and imputed wages are used to compute the values reported in columns (2) through (7). Column (2) gives the mean of log. establishment daily wage across all establishments in the sample. The values reported in column (3) are obtained by taking the average over all intra-establishment standard deviations in a given year, and the corresponding standard deviation over all establishments is provided in parentheses in the same column. Column (8) gives the intra-establishment residual inequality, or $\sigma_{jt}$ (see section III).

## Table 2: Fractional Panel Probit Estimation of the Labor Demand Model

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | 0.374**<br>(0.041) | 0.380**<br>(0.042) | 0.333**<br>(0.045) | 0.329**<br>(0.046) |
| Log. wage dispersion | -0.053*<br>(0.027) | -0.096**<br>(0.033) | -0.103**<br>(0.024) | -0.144**<br>(0.029) |
| Log. of skewness of wage dispersion | | -0.004*<br>(0.002) | | -0.006**<br>(0.002) |
| Log. average 12-month Euribor | 3.641**<br>(0.128) | 3.643**<br>(0.129) | 3.596**<br>(0.129) | 3.604**<br>(0.130) |
| Log. turnover | -0.164**<br>(0.008) | -0.165**<br>(0.008) | -0.165**<br>(0.008) | -0.165**<br>(0.008) |
| Share of part-time workers | 0.043<br>(0.038) | 0.043<br>(0.038) | 0.040<br>(0.038) | 0.038<br>(0.038) |
| Share of temp. Employed | 0.101*<br>(0.049) | 0.110*<br>(0.049) | 0.113*<br>(0.048) | 0.110*<br>(0.048) |
| Share of employed persons subjected to the social insurance scheme | 0.059<br>(0.070) | 0.031<br>(0.069) | 0.027<br>(0.070) | 0.026<br>(0.071) |
| Share of female workers | 0.005<br>(0.039) | 0.011<br>(0.038) | 0.008<br>(0.038) | 0.015<br>(0.038) |
| Share of low skilled workers | 0.039*<br>(0.018) | 0.041*<br>(0.018) | 0.040*<br>(0.018) | 0.041*<br>(0.018) |
| Share of non-German workers | 0.314*<br>(0.134) | 0.293*<br>(0.117) | 0.293*<br>(0.117) | 0.295*<br>(0.118) |
| Constant | -3.260**<br>(0.266) | -3.151**<br>(0.267) | -2.998**<br>(0.266) | -3.001**<br>(0.267) |
| Log. Pseudolikelihood | -18,785 | -18,747 | -18,750 | -18,744 |
| Wald-Test $\chi^2$ (df.) | 9,350**<br>(278) | 9,462**<br>(292) | 9,378**<br>(278) | 9,416**<br>(292) |
| Obs.<br>(Establ.) | 39,009<br>(12,967) | 38,922<br>(12,921) | 38,922<br>(12,921) | 38,922<br>(12,921) |

Source: LIAB 1996-2008.

Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve), a dummy for western Germany respective coverage by a collective agreement, the mean of time variant explanatory variables, dummies for the number of observations for an establishment and interaction variables between the means and the dummies. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

The STATA option „cluster" is used to calculate the clustered sandwich estimator to obtain a robust variance estimate that adjusts for within-cluster correlation. The STATA code to estimate the fractional panel probit model is provided in Wooldridge (2011).

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

**Table 3: Fixed Effects Estimation of the Labor Demand Model / logit transformation of the dependent variable**

| | (a) | (b) | (c) | (e) |
|---|---|---|---|---|
| Log. of wages | 0.570** (0.118) | 0.531** (0.075) | 0.456** (0.083) | 0.455** (0.083) |
| Log. wage dispersion | -0.113* (0.052) | -0.141** (0.044) | -0.198** (0.040) | -0.227** (0.047) |
| Log. of skewness of wage dispersion | | -0.001 (0.002) | | -0.004 (0.002) |
| Log. turnover | -0.249** (0.008) | -0.248** (0.008) | -0.248** (0.008) | -0.248** (0.008) |
| Share of part-time workers | 0.079 (0.050) | 0.073 (0.049) | 0.075 (0.049) | 0.076 (0.049) |
| Share of temp. Employed | 0.291** (0.064) | 0.307** (0.060) | 0.304** (0.060) | 0.304** (0.060) |
| Share of employed persons subjected to the social insurance scheme | -0.091 (0.101) | -0.101 (0.093) | -0.104 (0.093) | -0.103 (0.093) |
| Share of female workers | 0.028 (0.052) | 0.029 (0.050) | 0.028 (0.050) | 0.029 (0.050) |
| Share of low skilled workers | 0.031 (0.024) | 0.036 (0.023) | 0.036 (0.023) | 0.036 (0.023) |
| Share of non-German workers | 0.686** (0.239) | 0.157 (0.169) | 0.151 (0.168) | 0.151 (0.168) |
| Adj R-squared | 0.8881 | 0.8980 | 0.8982 | 0.8982 |
| F-test | 216.25** (84; 25,958) | 238.18** (85; 25,916) | 245.93** (84; 25,917) | 245.53** (85; 25,916) |
| Obs. (Establ.) | 39,009 (12,967) | 38,922 (12,921) | 38,922 (12,921) | 38,922 (12,921) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve) and a dummy for western Germany respective coverage by a collective agreement. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages, columns (e) and (f) use coefficient of variation of log. of observed wages.

Tables 2 and 3 contain the results for the fixed effects regressions and the fractional panel probit model of labor demand, where the standard deviation of wages and the residual wage inequality at the time of observation are used as measures of wage dispersion. The results for other instruments for the wage dispersion like the coefficient of variation or the 90-10 wage gap respective the 50-10 wage gap give no further insight to the topic and, therefore, are presented in the appendix (tables A.2 to A.5). In both tables the most results of the other variables show the expected signs and size. In both models, the influence of the log. of turnover is significant but negative. The elasticities for wage and turnover are negative, respectively positive, as expected from theory. The size of the calculated values from the fixed effects model confirm the estimates from previous studies (Addison & Teixeira 2001, Flaig & Rottmann 2001, Reimers 2001), while the results from the fractional panel probit model are some points larger in absolute figures than in the literature. The results for the log. of Euribor in table 2 would indicate that capital and labor are substitutes as the demand for labor increases while the price for capital becomes larger. Because of the within transformation, it is not possible to derive an estimate for the cost of capital in the fixed effects model.

The other results in Table 2 give some support that labor demand grows, when the share of temporary, non-german and low skilled workers increase, while all other shares remain insignificant. The results of the fixed effects model in table 3 confirm that the share of temporary workers has a significant positive influence on labor demand. With one exception in column (a), all other share variables are insignificant.In both tables the results for the wage dispersion indicate a significant negative influence on labor demand. Independently of the definition of wage dispersion as the actual standard deviation of intra-firm wages or as a residual wage inequality, the results would indicate that a larger wage dispersion is associated with a smaller labor demand. The calculated average elasticities according to the equations (9a) and (9b) are in between -0.04 and -0.17 (see appendix, tables A.6 and A.7). Also, the results for the fractional panel probit model in table 2 indicate significant negative parameter estimates for the skewness of the wage distribution. This means that labor demand decrease when the remuneration becomes more compressed at the lower tail of the wage distribution. The results would support the assumptions of either that a larger wage dispersion is a sign of frictions in the labor market or that a larger wage dispersion affects the fairness attitudes of workers and therefore reduce their efforts and productivity. On the other side, these results maybe suffer from severe problems as the distribution of wages is a result of the firms hiring and lay off activities. Thus, it is possible that the outcome is biased by an endogeneity problem in the model.

**Table 4: Fractional Panel Probit Estimation of the Labor Demand Model (lagged wage dispersion)**

| | (a) | (b) | (c) | (e) |
|---|---|---|---|---|
| Log. of wages | 0.109** (0.012) | 0.096** (0.011) | 0.099** (0.013) | 0.056** (0.007) |
| Log. wage dispersion (t-1) | -0.002 (0.008) | -0.009 (0.009) | -0.003 (0.006) | -0.004 (0.005) |
| Log. of skewness of wage dispersion (t-1) | | 0.000 (0.000) | | 0.000 (0.000) |
| Log. average 12-month Euribor | 0.068** (0.013) | 0.057** (0.012) | 0.064** (0.013) | 0.036** (0.007) |
| Log. turnover | -0.044** (0.002) | -0.041** (0.002) | -0.044** (0.002) | -0.025** (0.001) |
| Share of part-time workers | 0.021 (0.013) | 0.019 (0.012) | 0.020 (0.013) | 0.011 (0.007) |
| Share of temp. Employed | 0.017 (0.015) | 0.021 (0.014) | 0.021 (0.015) | 0.012 (0.008) |
| Share of employed persons subjected to the social insurance scheme | 0.022 (0.024) | 0.019 (0.022) | 0.022 (0.024) | 0.012 (0.014) |
| Share of female workers | -0.004 (0.013) | -0.003 (0.012) | -0.003 (0.013) | -0.001 (0.007) |
| Share of low skilled workers | 0.001 (0.006) | 0.001 (0.006) | 0.001 (0.006) | 0.001 (0.003) |
| Share of non-German workers | 0.113** (0.039) | 0.096** (0.036) | 0.103** (0.038) | 0.059** (0.022) |
| Constant | 0.857** (0.134) | 0.831** (0.128) | 0.874** (0.139) | 0.528** (0.081) |
| Log. Pseudolikelihood | -12,972 | -12,958 | -12,962 | -12,956 |
| Wald-Test $\chi^2$ (df.) | 94,476** (239) | 69,695** (275) | 11,405** (262) | 18,302** (275) |
| Obs. (Establ.) | 26,555 (8,638) | 26,536 (8,629) | 26,536 (8,629) | 26,536 (8,629) |

Source: LIAB 1996-2008.

Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve), a dummy for western Germany respective coverage by a collective agreement, the mean of time variant explanatory variables, dummies for the number of observations for an establishment and interaction variables between the means and the dummies. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

The STATA option „cluster“ is used to calculate the clustered sandwich estimator to obtain a robust variance estimate that adjusts for within-cluster correlation. The STATA code to estimate the fractional panel probit model is provided in Wooldridge (2011).

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

**Table 5: Fixed Effects Estimation of the Labor Demand Model / logit transformation of the dependent variable (lagged wage dispersion)**

| | (a) | (b) | (c) | (e) |
|---|---|---|---|---|
| Log. of wages | 0.637**<br>(0.131) | 0.581**<br>(0.114) | 0.583**<br>(0.115) | 0.582**<br>(0.115) |
| Log. wage dispersion (t-1) | 0.002<br>(0.035) | -0.025<br>(0.045) | 0.011<br>(0.031) | -0.004<br>(0.040) |
| Log. of skewness of wage dispersion (t-1) | | -0.003<br>(0.003) | | -0.002<br>(0.003) |
| Log. turnover | -0.230**<br>(0.010) | -0.230**<br>(0.009) | -0.230**<br>(0.009) | -0.230**<br>(0.009) |
| Share of part-time workers | 0.105<br>(0.056) | 0.101<br>(0.056) | 0.100<br>(0.056) | 0.101<br>(0.056) |
| Share of temp. Employed | 0.275**<br>(0.077) | 0.313**<br>(0.072) | 0.312**<br>(0.072) | 0.313**<br>(0.072) |
| Share of employed persons subjected to the social insurance scheme | -0.239*<br>(0.117) | -0.234*<br>(0.115) | -0.233*<br>(0.115) | -0.234*<br>(0.115) |
| Share of female workers | -0.014<br>(0.062) | -0.011<br>(0.062) | -0.012<br>(0.062) | -0.011<br>(0.062) |
| Share of low skilled workers | 0.002<br>(0.028) | 0.004<br>(0.028) | 0.004<br>(0.028) | 0.004<br>(0.028) |
| Share of non-German workers | 0.783**<br>(0.304) | 0.680*<br>(0.301) | 0.683*<br>(0.301) | 0.681*<br>(0.301) |
| Adj R-squared | 0.9003 | 0.9022 | 0.9022 | 0.9022 |
| F-test | 244.16**<br>(82; 17,835) | 232.13**<br>(83; 17,824) | 239.06**<br>(82; 17,825) | 232.95**<br>(83; 17,824) |
| Obs.<br>(Establ.) | 26,555<br>(8,638) | 26,536<br>(8,629) | 26,536<br>(8,629) | 26,536<br>(8,629) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve) and a dummy for western Germany respective coverage by a collective agreement. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages, columns (e) and (f) use coefficient of variation of log. of observed wages.

To take into account that the wage dispersion is maybe influenced by actual changes in the firms' workforce, the estimates presented in tables 4 and 5 use the lagged values of wage inequality as instruments for the actual size of the variables. As the adjustment processes in labor demand normally take place within one year (Hamermesh 1993, 253pp.), it is reasonable to assume that this should be a valid instrument in the regressions. The estimates for the other variables in the fixed effects model presented in table 5 only change slightly while the parameters for the share of non-german workers and workers subject to the social insurance scheme are now significant but stay with the same sign as in table 3. In the fractional panel probit regressions the parameters become remarkably smaller and partly insignificant for some share variables, but again there is no change in parameter signs. In both tables the result for the wage dispersion variables becomes insignificant in all regressions. This would mean, that the outcome for wage inequality in the tables 2 and 3 is heavily biased and that there is no overall influence of wage dispersion on labor demand.

On the other hand this result maybe occurs because two opposite effects neutralize each other. In the theoretical model in equation (5) two different sources of an impact of wage dispersion on labor demand are analyzed. The first one uses errors in the predictions of individual productivity during the hiring process, the second one assumes an influence of wage dispersion on the firms' overall productivity. As it is possible that both effects have a different direction, the overall effect is maybe insignificant. To control whether this is the reason for the insignificant regression outcome of the wage dispersion variables, interaction variables between wage inequality and log. of turnover respective the log of wages are introduced to estimations. These interaction variables would also catch size effects, whether the firm size (turnover) or the wage level influence the effect of wage inequality on labor demand. Thus tables 6 and 7 contain the results of the fractional panel probit respective the fixed effects regressions where the interaction variables are added to the estimations.

**Table 6: Fractional Panel Probit Estimation of the Labor Demand Model (lagged wage dispersion, interaction variables)**

| | (a) | (b) | (c) | (e) |
|---|---|---|---|---|
| Log. of wages | 0.054**<br>(0.008) | 0.093**<br>(0.014) | 0.082**<br>(0.016) | 0.098**<br>(0.024) |
| Log. wage dispersion (t-1) | -0.119*<br>(0.059) | 0.063<br>(0.117) | -0.095<br>(0.074) | 0.016<br>(0.093) |
| Log. wage dispersion (t-1) · Log. of wages | 0.033**<br>(0.012) | 0.046<br>(0.024) | 0.038*<br>(0.016) | 0.036<br>(0.020) |
| Log. wage dispersion (t-1) · Log. turnover | -0.001<br>(0.004) | -0.017<br>(0.009) | -0.005<br>(0.006) | -0.011<br>(0.008) |
| Log. of skewness of wage dispersion (t-1) | | 0.030**<br>(0.007) | | 0.030**<br>(0.009) |
| Log. of skewness of wage dispersion (t-1) · Log. of wages | | -0.003<br>(0.002) | | -0.004<br>(0.002) |
| Log. of skewness of wage dispersion (t-1) · Log. turnover | | -0.001*<br>(0.000) | | -0.001<br>(0.001) |
| Log. average 12-month Euribor | 0.038**<br>(0.007) | 0.061**<br>(0.013) | 0.061**<br>(0.015) | 0.070**<br>(0.019) |
| Log. turnover | -0.025**<br>(0.001) | -0.042**<br>(0.003) | -0.042**<br>(0.001) | -0.047**<br>(0.008) |
| Share of part-time workers | 0.012<br>(0.007) | 0.022<br>(0.013) | 0.020<br>(0.012) | 0.023<br>(0.015) |
| Share of temp. Employed | 0.009<br>(0.009) | 0.022<br>(0.015) | 0.021<br>(0.015) | 0.024<br>(0.017) |
| Share of employed persons subjected to the social insurance scheme | 0.012<br>(0.014) | 0.022<br>(0.024) | 0.020<br>(0.024) | 0.026<br>(0.028) |
| Share of female workers | -0.002<br>(0.008) | -0.003<br>(0.013) | -0.003<br>(0.013) | -0.003<br>(0.015) |
| Share of low skilled workers | 0.000<br>(0.004) | 0.002<br>(0.006) | 0.001<br>(0.006) | 0.001<br>(0.007) |
| Share of non-German workers | 0.064**<br>(0.023) | 0.104**<br>(0.039) | 0.101**<br>(0.038) | 0.119*<br>(0.047) |
| Constant | 0.524**<br>(0.080) | 0.934**<br>(0.144) | 0.914**<br>(0.178) | 1.100**<br>(0.188) |
| Log. Pseudolikelihood | -12,972 | -12,958 | -12,962 | -12,956 |
| Wald-Test $\chi^2$ (df.) | 16,758**<br>(263) | 18,249**<br>(279) | 110,000**<br>(262) | 213,706**<br>(279) |
| Obs.<br>(Establ.) | 26,555<br>(8,638) | 26,536<br>(8,629) | 26,536<br>(8,629) | 26,536<br>(8,629) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve), a dummy for western Germany respective coverage by a collective agreement, the mean of time variant explanatory variables, dummies for the number of observations for an establishment and interaction variables between the means and the dummies. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

The STATA option „cluster“ is used to calculate the clustered sandwich estimator to obtain a robust variance estimate that adjusts for within-cluster correlation. The STATA code to estimate the fractional panel probit model is provided in Wooldridge (2011).

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

**Table 7: Fixed Effects Estimation of the Labor Demand Model / logit transformation of the dependent variable (lagged wage dispersion, interaction variables)**

| | (a) | (b) | (c) | (e) |
|---|---|---|---|---|
| Log. of wages | 0.618**<br>(0.144) | 0.587**<br>(0.127) | 0.556**<br>(0.146) | 0.575**<br>(0.147) |
| Log. wage dispersion (t-1) | -1.009*<br>(0.487) | -0.857<br>(0.562) | -0.755<br>(0.417) | -0.635<br>(0.468) |
| Log. wage dispersion (t-1) · Log. of wages | 0.055<br>(0.127) | -0.055<br>(0.136) | 0.044<br>(0.103) | -0.007<br>(0.111) |
| Log. wage dispersion (t-1) · Log. turnover | 0.052<br>(0.029) | 0.072*<br>(0.037) | 0.039<br>(0.022) | 0.045<br>(0.026) |
| Log. of skewness of wage dispersion (t-1) | | 0.022<br>(0.035) | | 0.029<br>(0.035) |
| Log. of skewness of wage dispersion (t-1) · Log. of wages | | -0.013<br>(0.009) | | -0.012<br>(0.009) |
| Log. of skewness of wage dispersion (t-1) · Log. turnover | | 0.002<br>(0.002) | | 0.001<br>(0.002) |
| Log. turnover | -0.240**<br>(0.012) | -0.244**<br>(0.013) | -0.242**<br>(0.012) | -0.244**<br>(0.013) |
| Share of part-time workers | 0.104<br>(0.056) | 0.098<br>(0.056) | 0.098<br>(0.056) | 0.098<br>(0.056) |
| Share of temp. Employed | 0.273**<br>(0.077) | 0.310**<br>(0.072) | 0.311**<br>(0.072) | 0.310**<br>(0.072) |
| Share of employed persons subjected to the social insurance scheme | -0.238*<br>(0.117) | -0.229*<br>(0.114) | -0.234*<br>(0.115) | -0.232*<br>(0.114) |
| Share of female workers | -0.012<br>(0.062) | -0.009<br>(0.061) | -0.011<br>(0.061) | -0.010<br>(0.062) |
| Share of low skilled workers | 0.003<br>(0.028) | 0.005<br>(0.028) | 0.005<br>(0.028) | 0.005<br>(0.028) |
| Share of non-German workers | 0.779*<br>(0.304) | 0.680*<br>(0.300) | 0.677*<br>(0.300) | 0.679*<br>(0.300) |
| Adj R-squared | 0.9004 | 0.9023 | 0.9022 | 0.9023 |
| F-test | 232.51**<br>(84; 17,833) | 218.37**<br>(87; 17,820) | 225.55**<br>(84; 17,823) | 223.13**<br>(87; 17,820) |
| Obs.<br>(Establ.) | 26,555<br>(8,638) | 26,536<br>(8,629) | 26,536<br>(8,629) | 26,536<br>(8,629) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve) and a dummy for western Germany respective coverage by a collective agreement. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

While the size and significance of the other estimated parameters do not alter dramatically, the parameter estimate for the residual wage inequality in column (a) becomes significant, indicating an average elasticity of -0.084 (see table A.10 in appendix). In addition, the effect is significantly larger in absolute terms, when the firms' wage level is low. If the skewness of the wage distribution is introduced to the regression, the results for the residual wage inequality are insignificant, but it seems that the distribution of wages still influence labor demand through the skewness of wage distribution. When the skewness decreases by 10%, e.g. because of a larger lower tail of the firms' wage distribution, labor demand would also decrease by 0.2%. This is possibly the case when the share of low paid increase in an establishment. The estimations with the log. of standard deviation of wages in column (c) and (d) confirm the outcome for the interaction variable for the wage inequality and wage level in (c) and the skewness in (d). The estimate for the wage dispersion in (c) is also negative as in column (a) but insignificant.

The results in table 7 for the fixed effects regressions mainly repeat the results of the fractional panel probit estimates, with the exception that the parameters of the skewness of wage distribution and most of the interaction variables are insignificant now, although the parameters have the same signs. Also, the estimated elasticity of the residual wage dispersion is -0.792 and thus ten times larger than in the fractional panel probit regressions, while the absolute average wage elasticity is about 0.4 points lower, but the results are in line with previous studies that calculate labor demand elasticities for Germany (Addison & Teixeira 2001, Flaig & Rottmann 2001 and Reimers 2001). The results of the analysis are now summarized in the next section.

## 6. Conclusions

This paper uses linked employer employee data from Germany from the years of 1996 through 2008 to analyze the influence of wage inequality on the demand for labor. Many studies that have investigated wage dispersion have focused on firm productivity. In this study, we find that theoretical considerations deal with different ways of determining how the wage dispersion is related to the firms' employment. Matching models were found to propose a positive relationship among wages, compressing union behavior and legal minimum wages, irrespective of the overemployment of some groups of workers (Stole & Zwiebel 1996).

In the long run, establishments with higher productivity should have higher employment, because these firms are more likely to be successful on the market. There should be a positive relationship of wage dispersion and employment when efficiency and tournament wages increase the firms' productivity, while there should be a negative relationship, when a high wage dispersion is a sign of stronger frictions in the matching process (Fitzenberger & Garloff 2008) or if there is a strong notion of fairness in the workers beliefs. Higher wage dispersion would violate these beliefs and therefore decrease the firms productivity and employment in the long run.

To accomplish our goals, two empirical regression methods are used to test the data. The first is a non-linear share equation. It is estimated directly with a fractional panel probit model following Papke and Wooldridge (2008). The second is the estimation of the less efficient first differences model (FD), where the dependent variable, the share of labor costs, is modified by a log-odds transformation. The standard error of residual wages of the firm, the standard deviation of the log. of firms' wages and the skewness of the wage distribution are implemented in the regressions to indicate the influence of wage dispersion on the employment of establishments. Because of possible endogeneity problems, lagged values of the measures of wage dispersion are used. Similar results occur for both estimations.

The parameters of the covariates of the theoretical model are strongly significant and are of a reasonable size compared to the existing literature. The variables that measure wage dispersion are negative and statistically significant, when the residual wage inequality and interaction variables with turnover and wage level are introduced to the regressions. This result alters, if measures of the skewness of the wage dispersion are used as covariates. The effect of the standard error of the residual wages becomes insignificant then and the measures for skewness are significantly positive. At the establishment level, this result would support the assumption, that a higher wage dispersion is related to frictions in the matching process respectively supports that fairness attitudes of the employers negatively affect productivity and therefore the employment level of an establishment if wage dispersion increases, at least at the lower tail of the wage distribution. Therefore, it is recommended that this result should be tested in the future with other datasets in which the model allows for heterogeneous workers.

# Literature


Addison, J. T., Bellmann, L., Schank, T. & Teixeira, P. (2008): The Demand for Labor: An Analysis Using Matched Employer–Employee Data from the German LIAB. Will the High Unskilled Worker Own-Wage Elasticity Please Stand Up? Journal of Labor Research, 29(2), 114-137.

Addison, J. T., Kölling, A. & Teixeira, P. (2014): Changes in Collective Bargaining and Intra-Plant Wage Dispersion: Almost But Not Quite a Case of Plus ça Change, IZA Discussion Paper No. 8359, Bonn.

Addison, J. T. & Teixeira, P. (2001): Employment Adjustment in a "Sclerotic" Labour Market: Comparing Portugal with Germany, Spain, and the United Kingdom. Journal of Economics and Statistics, 221(4), 353-370.

Akerlof, G. A. & Yellen, J. (1990): The Fair Wage-Effort Hypothesis and Unemployment. Quarterly Journal of Economics, 105(2), 255-283.

Bauer, T. K., Kluve, J. Schaffner, S. & Schmidt, C. M. (2009): Fiscal Effects of Minimum Wages: An Analysis for Germany. German Economic Review, 10(5), 224 - 242.

Berndt, E. R. & Khaled, M. S. (1979): Parametric Productivity Measurement and Choice among Flexible Functional Forms. Journal of Political Economy, 87, 1220 - 1245.

Braakmann, N. (2008): Intra-Firm Wage Inequality And Firm Performance – First Evidence From German Linked Employer-Employee-Data. Working Paper 77 (Series in Economics), University of Lüneburg, Germany.

Cahuc, P., Marque, F. & Wasmer, E. (2008): A Theory of Wages and Labor Demand with Intra-Firm Bargaining and Matching Frictions. International Economic Review 49(3), 943-972.

Card, D., Heining, J. & Kline, P. (2013): Workplace Heterogeneity and the Rise of West German Wage Inequality. Quarterly Journal of Economics 128(3): 967-1015.

Dorner, M., Heining, J., Jacobebbinghaus, P. & Seth, S. (2010): Sample of Integrated Labour Market Biographies (SIAB) 1975-2008. FDZ Methodenreport No. 09/2010, Nuremberg.

Fabbri, F. & Marin, D. (2012): What Explains the Rise in CEO Pay in Germany? A Panel Data Analysis for 1977-2009. IZA Discussion Paper No. 6420, March 2012, Bonn.

Falk, M. & Koebel, B. (2001): A Dynamic Heterogeneous Labour Demand Model for German Manufacturing. Applied Economics, 33(3), 339-348.

Falk, M. & Koebel, B. (2004): The Impact of Office Machinery, and Computer Capital on the Demand for Heterogeneous Labour. Labour Economics, 11(1), 99-117.

Fischer, G., Janik, F., Müller, D. & Schmucker, A. (2008): The IAB Establishment Panel - From Sample to Survey to Projection. FDZ Methodenreport No. 01/2008, Nuremberg.

Fischer, G., Janik, F., Müller, D. & Schmucker, A. (2009): The IAB Establishment Panel - Things Users Should Know. Journal of Applied Social Science Studies, 129(1), 133-148.

Fitzenberger, B. & Garloff, A. (2008): Unemployment, labor market transitions and residual wage dispersion. Scottish Journal of Political Economy, 55(5), 561-590.

Flaig, G. & Rottmann, H. (2001): Input Demand and the Short- and Long-Run Employment Thresholds: An Empirical Analysis for the German Manufacturing Sector. German Economic Review, 2(4), 367–384.

Freier, R. & Steiner, V. (2010): Marginal Employment and the Demand for Heterogeneous Labour: Empirical Evidence from a Multi-Factor Labour Demand Model for Germany. Applied Economics Letters, 17(12), 1177-1182.

Frey, B. S. (1997): On the Relationship between Intrinsic and Extrinsic work Motivation. International Journal of Industrial Organization, 15(4), 427-439.

Gartner, H. (2005): The Imputation of Wages Above the Contribution Limit with the German IAB Employment Sample. FDZ Methodenreport No. 2/2005. Nuremberg.

Garibaldi, P. (2006): Personnel Economics in Imperfect Labour Markets. New York.

Groshen, E. L. (1991): Five Reasons Why Wages Vary Among Employers. Industrial Relations, 30(3), 350–381.

Grund, C. and Westergaard-Nielsen, N. (2008): The Dispersion of Employees' Wage Increases And Firm Performance. Industrial and Labor Relations Review, 61, 485-501.

Hamermesh, D. S. (1993): Labor Demand, Princeton, NJ, Princeton University Press.

Hunnes, A (2009): Internal Wage Dispersion And Firm Performance: White-Collar Evidence. International Journal of Manpower, 30, 776-796.

Jacobebbinghaus, P. & Seth, S. (2010): Linked Employer-Employee Data from the IAB : LIAB Cross-Sectional Model 2 1993-2008 (LIAB QM2 9308). FDZ Datenreport No. 05/2010.

Jacobi, L. & Schaffner, S. (2008): Does Marginal Employment Substitute Regular Employment? - A Heterogeneous Dynamic Labor Demand Approach for Germany. Ruhr Economic Papers No. 56. RWI, Essen.

Jirjahn, U & Kraft, K (2007): Intra-Firm Wage Dispersion And Firm Performance – Is There A Uniform Relationship? Kyklos, 60, 231-253.

Kölling, A. & Schank, T. (2004): Skill Biased Technological Change, International Trade, and the Wage Structure. New Evidence on the Determinants of the Employment Structure from Linked Employer-Employee Panel Data for Germany. In: Bellmann, L. and Hujer, R. (ed.): Betriebliche Innovationen im Spiegel von Betriebsbefragungen. Beiträge zur Arbeitsmarkt- und Berufsforschung, 277: 113 - 134.

Krugman, P. (1994): Past and Prospective Causes of High Unemployment. In Federal Reserve Bank of Kansas City (ed.): Reducing Unemployment: Current Issues and Policy Options, Proceedings of a Symposium in Jackson Hole, WY, 66 – 81.

Lallemand, T, Plasman, R & Rycx, F (2007): Wage Structure And Firm Productivity In Belgium. NBER Working Paper 12978.

Lazear, E. P. (1989): Pay Equality and Industrial Politics. Journal of Political Economy, 97(3), 561-580.

Lazear, E, P. (2000): Performance Pay and Productivity. American Economic Review, 90(5), 1346-1361.

Mahy, B.; Rycx, F. & Volral, M. (2011): Does Wage Dispersion Make All Firms Productive? Scottish Journal of Political Economy 58(4), 455-489.

Martins, P (2008), Dispersion in Wage Premiums And Firm Performance. Economics Letters, 101, 63-65.

Milgrom, P. & Roberts, J. (1990): The Economics of Modern Manufacturing: Technology, Strategy and Organization. American Economic Review, 80(3), 511–28.

Mortensen, D. T. (2010): Wage Dispersion in the Search and Matching Model. American Economic Review, 100(2), 338-42.

Mortensen, D. T. & Pissarides, C. A. (2011): Job Matching, Wage Dispersion, and Unemployment. Oxford, Oxford University Press.

Müller, K.-U. (2009): How Robust are Simulated Employment Effects of a Legal Minimum Wage in Germany? A Comparison of Different Data Sources and Assumptions. Discussion Paper of the German Institute for Economic Research (DIW) No. 900, Berlin.

Papke, L. E. & Wooldridge, J. M. (1996): Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates. Journal of Applied Econometrics, 11(6), 619-632.

Papke, L. E. & Wooldridge, J. M. (2008): Panel Data Methods for Fractional Response Variables with an Application to Test Pass Rates. Journal of Econometrics, 145(1-2), 121-133.

Reimers, H. E. (2001): Labour Demand in Germany and Seasonal Cointegration. Allgemeines Statistisches Archiv, 85, 283–299.

Stole, L. A. & Zwiebel, J. (1996): Intra-Firm Bargaining under Non-binding Contracts. Review of Economic Studies 63(3), 375-410.

Winter-Ebmer, R. & Zweimüller, J. (1999): Intra-Firm Wage Dispersion and Firm Performance. Kyklos 52(4), 555-572.

Wooldridge, J. M. (2002): Econometric Analysis of Cross Section and Panel Data, Cambridge MA: MIT Press.

Wooldridge, J. M. (2010): Correlated Random Effects Models with Unbalanced Panels. Keynote Paper at the 2010 Annual Health Econometrics Workshop, Oct. 10-11 2010, University of Michigan, Ann Arbor.

Wooldridge, J. M. (2011): Fractional Response Models with Endogeneous Explanatory Variables and Heterogeneity. Paper Presented at the Stata Conference Chicago 2011, June 14-15 2011, Gleacher Center, Chicago.

# Appendix

**Table A.1: Variable description (establishments with more than 20 employees)**

| Variable | Obs. | Mean. | St. Dev. | Min. | Max. |
|---|---|---|---|---|---|
| Log. turnover | 52551 | 16.164 | 1.652 | 8.925 | 23.947 |
| Share of part-time workers | 82218 | 0.173 | 0.224 | 0 | 1 |
| Share of temp. Employed | 82437 | 0.075 | 0.165 | 0 | 1 |
| Share of employed persons subjected to the social insurance scheme | 82959 | 0.911 | 0.153 | 0 | 1 |
| Share of female workers | 82724 | 0.409 | 0.282 | 0 | 1 |
| Share of low skilled workers | 82685 | 0.212 | 0.258 | 0 | 0.999 |
| Est. Covered by a Collective Agreement (dummy, Yes=1) | 82619 | 0.854 | 0.353 | 0 | 1 |
| Share of non-German workers | 80410 | 0.046 | 0.086 | 0 | 1 |
| Dummy for Western Germany | 82960 | 0.617 | 0.486 | 0 | 1 |

Source: LIAB 1996 - 2008

**Table A.1: Fractional Panel Probit Estimations with Coefficient of Variation as Measure for Wage Dispersion**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | 0.199** (0.067) | 0.143* (0.072) | 0.093** (0.013) | 0.126** (0.018) |
| Log. wage dispersion | -0.118** (0.027) | -0.167** (0.033) | -0.002 (0.005) | -0.006 (0.007) |
| Log. of skewness of wage dispersion | | -0.006** (0.002) | | -0.001 (0.001) |
| Log. average 12-month Euribor | 3.436** (0.140) | 3.383** (0.142) | 0.061** (0.012) | 0.080** (0.017) |
| Log. turnover | -0.165** (0.008) | -0.165** (0.008) | -0.042** (0.002) | -0.058** (0.003) |
| Share of part-time workers | 0.040 (0.038) | 0.039 (0.038) | 0.019 (0.012) | 0.026 (0.017) |
| Share of temp. Employed | 0.112* (0.048) | 0.109* (0.048) | 0.020 (0.014) | 0.028 (0.019) |
| Share of employed persons subjected to the social insurance scheme | 0.030 (0.070) | 0.029 (0.071) | 0.022 (0.023) | 0.032 (0.032) |
| Share of female workers | 0.007 (0.038) | 0.014 (0.038) | -0.004 (0.012) | -0.003 (0.017) |
| Share of low skilled workers | 0.040* (0.018) | 0.040* (0.018) | 0.001 (0.006) | 0.002 (0.008) |
| Share of non-German workers | 0.292* (0.117) | 0.294* (0.118) | 0.100** (0.037) | 0.138** (0.051) |
| Dummy for Western Germany | 0.028* (0.012) | 0.026* (0.012) | 0.012** (0.004) | 0.016** (0.005) |
| Constant | -2.768** (0.276) | -2.682** (0.279) | 0.852** (0.140) | 1.244** (0.194) |
| Log. Pseudolikelihood | -18,750 | -18,744 | -12,962 | -12,957 |
| Wald-Test $\chi^2$ (df.) | 9,365** (278) | 9,407** (292) | 16,544** (262) | 19,801** (275) |
| Obs. (Establ.) | 38,922 (12,921) | 38,922 (12,921) | 26,536 (8,629) | 26,536 (8,629) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve), a dummy for western Germany respective coverage by a collective agreement, the mean of time variant explanatory variables, dummies for the number of observations for an establishment and interaction variables between the means and the dummies. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

The STATA option „cluster“ is used to calculate the clustered sandwich estimator to obtain a robust variance estimate that adjusts for within-cluster correlation. The STATA code to estimate the fractional panel probit model is provided in Wooldridge (2011).

Columns (a) and (b) use actual values, columns (c) and (d) contain lagged values of the coefficient of variation.

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**Table A.3: Fixed Effects Estimations with Coefficient of Variation as Measure for wage dispersion / logit transformation of the dependent variable**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | 0.456**<br>(0.083) | 0.455**<br>(0.083) | 0.599**<br>(0.119) | 0.599**<br>(0.121) |
| Log. wage dispersion | -0.198**<br>(0.040) | -0.227**<br>(0.047) | 0.036<br>(0.025) | 0.035<br>(0.030) |
| Log. of skewness of wage dispersion | | -0.004<br>(0.002) | | 0.000<br>(0.003) |
| Log. turnover | -0.248**<br>(0.008) | -0.248**<br>(0.008) | -0.230**<br>(0.009) | -0.230**<br>(0.009) |
| Share of part-time workers | 0.075<br>(0.049) | 0.076<br>(0.049) | 0.100<br>(0.056) | 0.100<br>(0.056) |
| Share of temp. Employed | 0.304**<br>(0.060) | 0.304**<br>(0.060) | 0.312**<br>(0.072) | 0.312**<br>(0.072) |
| Share of employed persons subjected to the social insurance scheme | -0.104<br>(0.093) | -0.103<br>(0.093) | -0.228*<br>(0.114) | -0.228*<br>(0.114) |
| Share of female workers | 0.028<br>(0.050) | 0.029<br>(0.050) | -0.013<br>(0.062) | -0.013<br>(0.062) |
| Share of low skilled workers | 0.036<br>(0.023) | 0.036<br>(0.023) | 0.004<br>(0.028) | 0.004<br>(0.028) |
| Share of non-German workers | 0.151<br>(0.168) | 0.151<br>(0.168) | 0.682*<br>(0.301) | 0.681*<br>(0.301) |
| Adj R-squared | 0.8982 | 0.8982 | 0.9022 | 0.9022 |
| F-test | 245.93**<br>(84; 25,917) | 245.53**<br>(85; 25,916) | 238.21**<br>(82; 17,825) | 234.94**<br>(83; 17,824) |
| Obs.<br>(Establ.) | 38,922<br>(12,921) | 38,922<br>(12,921) | 26,536<br>(8,629) | 26,536<br>(8,629) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve) and a dummy for western Germany respective coverage by a collective agreement. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

Columns (a) and (b) use actual values, columns (c) and (d) contain lagged values of the coefficient of variation.

**Table A.4: Fractional Panel Probit Estimations with Intra Firm Wage Relations as Measure for Wage Dispersion**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | 0.375**<br>(0.039) | 0.372**<br>(0.039) | 0.104**<br>(0.011) | 0.097**<br>(0.010) |
| Intra firm wage Relation (90th to 10th percentile) | -0.024**<br>(0.008) | -0.013<br>(0.029) | 0.000<br>(0.002) | 0.014<br>(0.008) |
| Intra firm wage Relation (50th to 10th percentile) | | -0.015<br>(0.030) | | -0.016<br>(0.009) |
| Log. average 12-month Euribor | 3.648**<br>(0.127) | 3.636**<br>(0.127) | 0.067**<br>(0.011) | 0.062**<br>(0.011) |
| Log. turnover | -0.166**<br>(0.008) | -0.166**<br>(0.008) | -0.046**<br>(0.002) | -0.043**<br>(0.002) |
| Share of part-time workers | 0.042<br>(0.038) | 0.040<br>(0.038) | 0.018<br>(0.012) | 0.017<br>(0.011) |
| Share of temp. Employed | 0.104*<br>(0.049) | 0.104*<br>(0.049) | 0.020<br>(0.014) | 0.020<br>(0.013) |
| Share of employed persons subjected to the social insurance scheme | 0.065<br>(0.073) | 0.067<br>(0.073) | 0.019<br>(0.022) | 0.019<br>(0.020) |
| Share of female workers | 0.006<br>(0.039) | 0.008<br>(0.039) | -0.007<br>(0.012) | -0.007<br>(0.011) |
| Share of low skilled workers | 0.038*<br>(0.018) | 0.039*<br>(0.018) | 0.008<br>(0.006) | 0.007<br>(0.005) |
| Share of non-German workers | 0.272*<br>(0.136) | 0.273*<br>(0.136) | 0.112**<br>(0.038) | 0.104**<br>(0.035) |
| Constant | -3.301**<br>(0.270) | -3.281**<br>(0.269) | 0.804**<br>(0.132) | 0.747**<br>(0.123) |
| Log. Pseudolikelihood | -18,747 | -18,744 | -14,278 | -14,276 |
| Wald-Test $\chi^2$ (df.) | 9,188**<br>(278) | 9,370**<br>(292) | 19,963**<br>(262) | 18,560**<br>(275) |
| Obs.<br>(Establ.) | 38,932<br>(12,953) | 38,932<br>(12,953) | 29,223<br>(9300) | 29,223<br>(9300) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve), a dummy for western Germany respective coverage by a collective agreement, the mean of time variant explanatory variables, dummies for the number of observations for an establishment and interaction variables between the means and the dummies. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

The STATA option „cluster“ is used to calculate the clustered sandwich estimator to obtain a robust variance estimate that adjusts for within-cluster correlation. The STATA code to estimate the fractional panel probit model is provided in Wooldridge (2011).

Columns (c) and (d) use lagged values for the wage relation.

**Table A.5: Fixed Effects Estimation with Intra Firm Wage Relations as Measure for Wage Dispersion / logit transformation of the dependent variable**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | 0.617**<br>(0.107) | 0.623**<br>(0.107) | 0.630**<br>(0.115) | 0.629**<br>(0.115) |
| Intra firm wage Relation (90th to 10th percentile) | -0.008<br>(0.013) | 0.085<br>(0.064) | -0.005<br>(0.012) | 0.045<br>(0.060) |
| Intra firm wage Relation (50th to 10th percentile) | | -0.100<br>(0.063) | | -0.056<br>(0.064) |
| Log. turnover | -0.248**<br>(0.008) | -0.248**<br>(0.008) | -0.239**<br>(0.009) | -0.239**<br>(0.009) |
| Share of part-time workers | 0.086<br>(0.050) | 0.084<br>(0.050) | 0.117*<br>(0.054) | 0.117*<br>(0.054) |
| Share of temp. Employed | 0.297**<br>(0.064) | 0.300**<br>(0.064) | 0.305**<br>(0.077) | 0.306**<br>(0.077) |
| Share of employed persons subjected to the social insurance scheme | -0.085<br>(0.100) | -0.084<br>(0.100) | -0.158<br>(0.109) | -0.155<br>(0.109) |
| Share of female workers | 0.032<br>(0.052) | 0.030<br>(0.052) | -0.024<br>(0.061) | -0.025<br>(0.061) |
| Share of low skilled workers | 0.031<br>(0.024) | 0.032<br>(0.024) | 0.034<br>(0.029) | 0.034<br>(0.029) |
| Share of non-German workers | 0.723**<br>(0.239) | 0.717**<br>(0.237) | 0.650*<br>(0.273) | 0.650*<br>(0.272) |
| Adj R-squared | 0.8886 | 0.8886 | 0.8957 | 0.8957 |
| F-test | 212.93**<br>(84, 25895) | 207.45**<br>(85, 25,894) | 162.08**<br>(82, 19,841) | 160.23**<br>(83, 19,840) |
| Obs.<br>(Establ.) | 38,932<br>(12,953) | 38,932<br>(12,953) | 29223<br>(9,300) | 29223<br>(9,300) |

Source: LIAB 1996-2008. Note: The model also includes the following dichotomous and auxiliary variables: establishment size (seven dummies), legal form (five), firm profitability (eight), industry (fourty), year (twelve) and a dummy for western Germany respective coverage by a collective agreement. Semi-robust standard errors adjusted for clustering on establishments and years in parentheses. ** and * denote significance at the .01 and .05 levels, respectively.

Columns (c) and (d) use lagged values for the wage relation.

**Table A.6: Average Elasticities from the Fractional Panel Probit Estimations in Table 2 (Equations 9b to 12b)**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | -0.735 | -0.734 | -0.767 | -0.770 |
| Log. wage dispersion | -0.038 | -0.067 | -0.072 | -0.101 |
| Log. of skewness of wage dispersion | | -0.003 | | -0.004 |
| Log. average 12-month Euribor | 2.579 | 2.546 | 2.513 | 2.518 |
| Log. turnover | 0.884 | 0.885 | 0.885 | 0.885 |

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

**Table A.7: Average Elasticities from the Fixed Effects Estimations in Table 3 (Equations 9a to 12a)**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| | Mean (s.d.) | Mean (s.d.) | Mean (s.d.) | Mean (s.d.) |
| Log. of wages | -0.553 (0.096) | -0.583 (0.090) | -0.642 (0.077) | -0.643 (0.077) |
| Log. wage dispersion | -0.089 (0.019) | -0.110 (0.024) | -0.155 (0.033) | -0.178 (0.038) |
| Log. of skewness of wage dispersion | | -0.001 (0.000) | | -0.003 (0.001) |
| Log. turnover | 0.805 (0.042) | 0.805 (0.042) | 0.805 (0.042) | 0.805 (0.042) |

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages. Because of the within transformation it is not possible to estimate elasticities for only time variant variables like the Euribor. Standard deviation of the estimated elasticities in parenthesis.

**Table A.8: Average Elasticities from the Fractional Panel Probit Estimations in Table 4 (Equations 9b to 12b)**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | -0.923 | -0.934 | -0.931 | -0.961 |
| Log. wage dispersion | -0.001 | -0.006 | -0.002 | -0.003 |
| Log. of skewness of wage dispersion | | -0.000 | | -0.000 |
| Log. average 12-month Euribor | 0.048 | 0.039 | 0.045 | 0.025 |
| Log. turnover | 0.969 | 0.972 | 0.970 | 0.983 |

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

**Table A.9: Average Elasticities from the Fixed Effects Estimations in Table 5 (Equations 9a to 12a)**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| | Mean (s.d.) | Mean (s.d.) | Mean (s.d.) | Mean (s.d.) |
| Log. of wages | -0.500 (0.108) | -0.544 (0.098) | -0.543 (0.098) | -0.543 (0.098) |
| Log. wage dispersion | 0.002 (0.000) | -0.020 (0.004) | 0.009 (0.002) | -0.003 (0.001) |
| Log. of skewness of wage dispersion | | -0.002 (0.000) | | -0.002 (0.000) |
| Log. turnover | 0.819 (0.039) | 0.819 (0.039) | 0.819 (0.039) | 0.819 (0.039) |

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages. Because of the within transformation it is not possible to estimate elasticities for only time variant variables like the Euribor. Standard deviation of the estimated elasticities in parenthesis.

**Table A.10: Average Elasticities from the Fractional Panel Probit Estimations in Table 6 (Equations 9b to 12b)**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| Log. of wages | -0.962 | -0.935 | -0.943 | -0.932 |
| Log. wage dispersion | -0.084 | 0.044 | -0.066 | 0.011 |
| Log. of skewness of wage dispersion | | 0.021 | | 0.021 |
| Log. average 12-month Euribor | 0.027 | 0.042 | 0.043 | 0.049 |
| Log. turnover | 0.982 | 0.971 | 0.971 | 0.967 |

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages.

**Table A.11: Average Elasticities from the Fixed Effects Estimations in Table 7 (Equations 9a to 12a)**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| | Mean (s.d.) | Mean (s.d.) | Mean (s.d.) | Mean (s.d.) |
| Log. of wages | -0.515 (0.104) | -0.540 (0.099) | -0.563 (0.094) | -0.549 (0.097) |
| Log. wage dispersion | -0.792 (0.170) | -0.673 (0.145) | -0.592 (0.127) | -0.499 (0.107) |
| Log. of skewness of wage dispersion | | 0.018 (0.004) | | 0.022 (0.005) |
| Log. turnover | 0.811 (0.041) | 0.808 (0.041) | 0.810 (0.041) | 0.808 (0.041) |

Columns (a) and (b) use standard error of regression (ser), columns (c) and (d) use standard deviation of log. of observed wages. Because of the within transformation it is not possible to estimate elasticities for only time variant variables like the Euribor. Standard deviation of the estimated elasticities in parenthesis.

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