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Changes in Union Membership Over Time: A Panel Analysis for West Germany

ZEW Discussion Papers, No. 03-42

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Suggested Citation: Fitzenberger, Bernd; Beck, Martin (2003) : Changes in Union Membership Over Time: A Panel Analysis for West Germany, ZEW Discussion Papers, No. 03-42, Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim

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Changes in Union Membership Over Time: A Panel Analysis for West Germany

Martin Beck and Bernd Fitzenberger

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Zentrum für Europäische Wirtschaftsforschung GmbH

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Non-technical Summary

Union membership in Germany has shown remarkable variation during the last two decades. While after the German unification union membership increased considerably, the German trade unions have suffered from a continuous decline since 1992. Union membership was at 13.7 millions in 1991 and it decreased to 10 millions in 1999. Union density, as the ratio of union membership to employed workers, has exhibited cyclic movements since the formation of trade unions in the nineteenth century. However, the present downward sloping trend of union density in most Western countries, which has taken place with short interruptions since the mid–1970s, causes a debate over the future prospects of trade unions in a post–industry economy. In Germany, the recent mergers of industry oriented unions are a response to the radical changes the unions are confronted with.

In order to assess the economic importance of unions and their bargaining power in the relevant industries, it is necessary to know the union density among employees. The officially available information about gross trade union membership is not sufficient in this regard because the numbers on union membership do not distinguish by employment status and industries. In addition, as of 1991 membership information is usually published only for unified Germany.

This paper analyzes the determinants of the propensity to join a union and examines the stability of the estimated union membership function over time. Obtaining evidence on the latter, we attempt to shed light on the question to what extent the ongoing decline in union membership can be explained by intertemporal changes in the workplace and firm specific environment, and in socioeconomic variables. We use four waves of the German Socioeconomic Panel in 1985, 1989, 1993, and 1998 to perform a panel analysis of net union membership among employees and we estimate a correlated random effects probit model suggested in Chamberlain (1984) to take proper account of individual specific effects. By using a block bootstrap estimator for the covariance matrix of the first stage estimator, we robustify Chamberlain's estimator.

As an indicator of the importance of unions, we estimate the share of unionized (employed) workers at the industry level by projecting the estimated union membership function based on the IAB employment subsample, a large data set of employees in West Germany.

Our empirical results suggest that at the individual level the propensity to be a union member has not changed considerably over time. Therefore, the aggregate decline in membership is due to composition effects. We also find a strong decline of net union density at the industry level during the 1990's based on the predicted union membership for the IAB employment subsample, i.e. the composition effect is also strongly working within industries. Our results suggest that unions have not become more attractive for

the types of workers who traditionally have a low propensity to be a union member and whose share has been increasing continuously over time. In order to stop the decline in aggregate union membership, unions would have to be much more successful in recruiting these types of workers.

Changes in union membership over time: A panel analysis for West Gemany [1]

Martin Beck[2] and Bernd Fitzenberger[3]

June 2003

Abstract: Despite the apparent stability of the wage bargaining institutions in West Germany, aggregate union membership has been declining dramatically since the early 90's. However, aggregate gross membership numbers do not distinguish by employment status and it is impossible to disaggregate these sufficiently. This paper uses four waves of the German Socioeconomic Panel in 1985, 1989, 1993, and 1998 to perform a panel analysis of net union membership among employees. We estimate a correlated random effects probit model suggested in Chamberlain (1984) to take proper account of individual specific effects. Our results suggest that at the individual level the propensity to be a union member has not changed considerably over time. Thus, the aggregate decline in membership is due to composition effects. We also use the estimates to predict net union density at the industry level based on the IAB employment subsample for the time period 1985 to 1997.

Keywords: union membership, gross and net union density, correlated random effects probit model

JEL Classification: J5

[1]This paper is part of the research project "Lohnverhandlungen, Lohnstruktur und Gütermarkt", for which we gratefully acknowledge financial support by the Deutsche Forschungsgemeinschaft (DFG). We thank Norbert Schanne for excellent editorial assistance. All errors are our sole responsibility.

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1 Introduction

Union membership in Germany has shown remarkable variation during the last two decades. While after the German unification union membership increased considerably, the German trade unions have suffered from a continuous decline since 1992. Union density, as the ratio of union membership to employed workers, has exhibited cyclic movements since the formation of trade unions in the nineteenth century. However, the present downward sloping trend of union density in most Western countries, which has taken place with short interruptions since the mid–1970s, causes a debate over the future prospects of trade unions in a post–industry economy. In Germany, the recent mergers of industry oriented unions are a response to the radical changes the unions are confronted with.

This paper analyzes the determinants of the propensity to join a union and examines the stability of the estimated union membership function over time. Obtaining evidence on the latter, we attempt to shed light on the question to what extent the ongoing decline in union membership can be explained by intertemporal changes in the workplace and firm specific environment, and in socioeconomic variables. In this context, we test the stability of the propensity to join a union or to stay in a union over time. Rigorous tests of stability over time have rarely been implemented in the literature. A recent study for Germany, Schnabel and Wagner (2003) estimates membership equations for different years, however, without testing for the significance of the differences over time.

The decision of a utility–maximizing individual to join a union can be explained as a result of a cost–benefit analysis. The membership decision is determined by monetary and non–monetary advantages and disadvantages. In the German context, monetary benefits of a union membership are relatively low compared to the membership fees. Monetary incentives of a union membership (strike payments) that might exceed the costs of joining a union are mainly restricted to selected industries in several regions ("Pilotbezirke"), where the wage bargaining process typically starts, and strikes sometimes occur.

However, many services provided by unions can be viewed as public goods among employees. Wage settlements bargained at the industry level are usually relevant for all workers independently of their union membership status and closed shops are legally prohibited in Germany. For this reason, a free–riding behavior of workers seems to be rational. In the absence of closed shops and discriminatory wage policy, there must be other non–monetary incentives to join a union (see Goerke and Pannenberg, 1998, Lorenz and Wagner, 1991, Schnabel, 1989, 2003, Schnabel and Wagner, 2003). We are taking into account selective incentives provided by unions as well as firm and industry related information.

Another issue addressed in this paper is the approximation of the actual strength of unions and their bargaining power in the relevant industries. The officially available

information about gross trade union membership is not sufficient to measure their importance on the labor market. First, the data published by trade unions usually do not distinguish between employed and non–employed members (Franz, 2003). Second, those unions which are organized in the German trade union association ("Deutscher Gewerkschaftsbund") are present in several sectors of the economy. Third, as of 1991 membership information is usually published only for unified Germany. For these reasons, the available aggregated data cannot provide an appropriate indicator for the actually strength and significance of trade unions for the German labor market. In order to provide such an indicator, we estimate the share of unionized (employed) workers at the industry level by projecting the estimated union membership function based on the IAB employment subsample (IABS), a large data set of employees in West Germany.

This paper extends upon the earlier study in Fitzenberger et al. (1999) which conducted a panel analysis of union membership in West Germany based on the German Socioeconomic Panel (GSOEP) for the years 1985, 1989, and 1993. This study used a GMM–estimator suggested by Avery, Hansen and Hotz (1983) in the empirical work. Here, we use a longer period by including the year 1998 and we are implementing a correlated random effects estimator suggested by Chamberlain (1984) in our empirical analysis. This estimator takes account of a potential individual specific correlation between unobserved individual specific effects and past, present, and future values of the regressors. By using a block bootstrap estimator for the covariance matrix of the first stage estimator, we robustify Chamberlain's estimator. In Fitzenberger et al. (1999), the older version of the IABS restricts the prediction of the union membership rates to the period until 1990. Here, we use the new version of the IABS that has only recently been made available enabling us to project our estimates up to 1997. Therefore, this study allows for a detailed analysis of the trends in union membership after German unification. Our results indicate, that the propensity to join a union for an employee with given characteristics has not changed significantly over time, but rather the composition of the workforce and the industry structure is mainly responsible for membership losses of German trade unions.

The remainder of the paper is organized as follows: Section 2 describes the recent trend in gross total union membership in West Germany. The theoretical arguments why individuals join a trade union are discussed in section 3. Section 4 presents the econometric model. The estimation results for the determinants of being member in a trade union based on the German Socioeconomic Panel can be found in section 5. Section 6 uses the estimates put forward in this paper to predict net union density based on the IAB employment subsample. Section 7 concludes. The appendix provides detailed information on the data and the empirical results.

2 Trends in union membership in West Germany

Table 1 shows the development of trade union members for the most important central union associations that publish reliable data. Whereas the four unions considered could increase their stock of members between 1960 and 1980 according to the overall increase of employment, the number of union members remains relatively constant in the 1980s. As a result of the German unification the biggest unions could considerably increase the number of their members. After 1991 the DGB suffers from the largest decline in membership. At the end of the 1990s, we observe a stabilization at a low level.

Table 1: Members of central union associations in thousand 1960–1999[a]

Jahr	DGB[b]	DBB[b]	DAG[b]	CGB[b]	sum.[c]
1960	6378	649	450	200	7762
1970	6712	720	461	190	8203
1980	7882	821	494	288	9486
1981	7957	820	499	294	9572
1982	7849	812	501	297	9459
1983	7745	801	497	299	9344
1984	7660	794	497	306	9259
1985	7719	796	500	307	9323
1986	7764	782	496	307	9350
1987	7757	785	494	307	9344
1988	7797	786	496	306	9387
1989	7861	793	503	304	9462
1990	7937	799	573	309	9619
1991	11800	1053	584	310	13749
1992	11015	1095	578	315	13004
1993	10290	1078	527	310	12207
1994	9768	1089	520	306	11684
1995	9354	1075	507	303	11239
1996	8972	1101	501	303	10877
1997	8263	1117	489	303	10172
1998	8311	1184	480	303	10278
1999	8037	1202	462	305	10006

a: Until 1990 for West Germany, afterwards for all Germany, in 1000.
b: DGB = Deutscher Gewerkschaftsbund, DBB = Deutscher Beamtenbund, DAG = Deutsche Angestelltengewerkschaft, CGB = Christlicher Gewerkschaftsbund
c: Members of the police union are also included in the sum in 1960 and 1970, even though they do not belong to the DGB.
Sources:
German Statistical Office ("Statistisches Bundesamt: Statistisches Jahrbuch für Deutschland").
DGB (1999): ("DGB: http://www.dgb.de/dgb/mitgliederzahlen/mitglieder.htm").

The interpretation of these statistics is quite problematic, because the published in-

formation about union members is not very reliable (Schnabel and Pege, 1992, p.13f, Institut der deutschen Wirtschaft, 1994. p.8, Schnabel, 1993). Moreover, unions only publish aggregate data for employed and non–employed members, and the membership information refers to all of Germany since 1991, restricting the comparability of the data before and after German unification.

In contrast to the absolute number of union members, the union density allows for a more meaningful evaluation of the importance and strength of unions. Throughout this paper we will call the ratio of union members relative to all employees in the unions' sphere of influence as the gross union density (GUD). The GUD can be calculated based on data from official statistics. However, the GUD overestimates the importance of trade unions in the labor market, because the numerator includes individuals who cannot appear in the denominator, for example unemployed people, retired workers, and students. What we are really interested in is an indicator of the importance and strength of unions in the labor market related to active (employed) members. For this reason, the net union density (NUD), which includes exclusively employed members in the numerator, seems to be the more appropriate reference number. Now, the problem in calculating the NUD is caused by the fact that the number of employed union members will not be published. In addition, a single union cannot be assigned unambiguously to the various industries, and sometimes there are several unions active in one industry. Even the assignment of the single union member to an industry is often unknown.

There are only a few studies which attempt to calculate the NUD at the industry level for Germany. Armingeon (1988) calculates the NUD for several industries until 1985. Lorenz and Wagner (1991) attempt to estimate the NUD for 29 manufacturing industries by multiplying the estimated coefficients based on individual data with the means of the corresponding industry variables. However, the authors neglect industry specific fixed effects in their regressions. We take account of these effects and project the resulting estimates for 46 industries from 1985 to 1997 using a comprehensive individual data set.

3 Determinants of trade union membership

Why do people join a union? In the anglo–american countries, there exist direct economic incentives for workers to become a union member (Bain and Elias, 1985, Fiorito et al., 1986). In these countries workers may be forced to join a union in order to get or to keep a job (closed shop). In addition, to be a union member often increases expected earnings. For example, for the U.S., Freeman and Medoff (1984) conclude that unionized workers earn significantly more than their non–unionized colleagues. However, direct economic incentives of a union membership are usually irrelevant for workers in Germany. This is the case for several reasons: First, wage settlements are

relevant for all workers within a firm that is a member of the employers' association and closed shops are legally prohibited. Second, via the so called coverage extension rule ("Allgemeinverbindlicherklärung"), firms that are not member of the employers' association can also be forced to adopt wage settlements by the government. Third, unions are restricted in discriminating between members and non–members by law ("negative Koalitionsfreiheit" based on article 9(3) of the German constitution). Fourth, employers tend not to discriminate non–unionized workers in order to prevent them from becoming union–members. These theoretical arguments are also empirically supported by Goerke and Pannenberg (1998), who find for Germany no significant impact of a union membership on earnings.

Nevertheless, there are plausible determinants of union membership. First of all, unions provide some selective incentives. For example, unions take the role of an insurance. They grant strike pay, take the risk of law–suits with the employer, and provide other services like legal advise exclusively for members. However, these incentives do not seem sufficient in explaining the rationale for paying the fairly high membership fees related with union membership. Moreover, influencing the unions' policy is usually not possible for a single union member. This problem was already emphasized as a central theme in Olson's theory of the "Logic of collective choice" (Olson, 1968). Second, in addition to economic incentives, the social dimension of a membership decision is deemed important. Social custom, reputation benefits, prestige, philosophy of life, and conformity to internalized norms may also be motives for joining a union (Corneo, 1995, Goerke and Pannenberg, 1998, Windolf and Haas, 1989). Under certain circumstances social coerce, in particular in "traditional" unionized industries like miners and steel workers, might be sufficient to move workers into a union. Without discussing these hypotheses in detail, our empirical analysis attempts to consider such non–economic motives of union membership. We use various socioeconomic variables which may be relevant for the importance of selective incentives or indicating social and vocational environment and the individual philosophy of life.

In light of the theoretical discussion of the determinants to join a union, we will shortly discuss the likely impact of several variables used in the empirical analysis in section 5. The various possible determinants of union–membership may be very different among workers. For some individuals, one motive may dominate their decision to join a union, but usually several reasons co–exist. The relevant variables are structured in three categories. First, individual characteristics and attitudes are relevant "intrinsic motives" for the need of protection , the choice of changing the job, and the costs caused by a job change ("exit" option). Second, the costs of establishing a union and providing services for their members depend on the composition of the workforce and firm or sector related conditions. Third, the monetary costs in the form of membership fees, as well as the non–monetary benefits and costs arising from the social environment at the working place, the presence and strength of unions and their acceptance by employers and employees are further important determinants of joining a union. In the following,

we differentiate between personal variables (1–6), a mix of individual and working place related variables (7–10) and firm specific conditions (11–12). The empirical analysis investigates the impact of these variables on the individual propensity to be a union member.

1. Age: The mobility of workers and the relationship to their working place may depend on the age of the worker. It is conceivable that elderly workers are tied more strongly to their job due to higher firm specific human capital and have a lower mobility caused by family ties. Union membership may increase job security since factory committee members, which are usually union members, are commonly involved in dismissal decisions. However, a correlation between the age and union membership may be due to cohort effects. Differences in the value orientation between generations may be responsible for different attitudes about unions or the kind of social custom and the pressure to join or to stay in a union.

2. Education: A higher skill–level is usually connected with a higher professional position and a closer relationship to management. On the one hand, the resulting higher individual labor performance also decreases the need of protection. On the other hand, higher education may be positively correlated with workplace related involvement of the worker and an increasing need of consultation and participation.

3. Sex: In general, females are less tied to the labor market due to family reasons and their lower average income compared to males, who are usually the prime earner in the household. For this reason (married) women are less affected by the possibility of a job loss. Moreover, in the past the unions' policy was mainly directed to the needs of males.

4. Marital status: Married workers are also responsible for their family, especially if they have children, and their mobility is restricted. For these reasons the need of protection should be higher for married people. On the other hand, if one partner in the marriage looses his/her job, the other partner could help to get over the period of unemployment. Overall, we expect that the former arguments dominate the latter.

5. Foreigner: The linkage of foreigners to the German labor market is often assumed to be weaker. However, unions are often attempting to avoid discrimination of foreigners.

6. Value orientation: Unions are traditionally closely linked to the social democrats through their common history and ideology. But being a large party, parts of the christian democrats have also close ties to the unions. We only consider the preference towards these two main parties in our empirical analysis as dummy variables (none of the two as third alternative).

7. Wage: Although benefits from a union membership typically do not dependent upon wages, membership fees are proportionally increasing with wages. With regard to monetary costs the propensity to join a union should decrease with increasing wages.

In addition, higher wages are – as well as a higher education – usually linked with a more superior position in the firm and a higher responsibility decreasing the probability of a union membership. However, higher wages are also an indicator of firm specific human capital, increasing the costs of loosing or changing the job. We expect a hump shaped relationship between wages and union membership. The effect should be positive for low wages and negative for higher wages.

8. Employee status: Unions traditionally emerged as organizations of blue collar workers. The relatively homogeneous preferences of blue–collar workers also makes is easier to organize them (see Hirsch/Addison, 1986, p.59). White collar workers are assumed to be closer to their employer. However, a higher expected desire for information and participation at the workplace may increase the activity of white collar workers in unions. There are also differences of expected union density with regard to working time, since the part–time working employees exhibit less attachment to the labor market. It is also more difficult to organize them.

9. Job Satisfaction: Dissatisfied workers often seek support by the union. If the employee recoils to debate with the employer, the work council responsible for workplace related issues and its members are often themselves union members. In addition, the probability of demanding legal advise or financial support in the case of a law–suit with the employer is higher for workers who are unhappy with their working conditions. In addition to their "exit" option, employees can opt for "voice" via union membership. If the union manages to support their members and adequately increase their satisfaction, the opposite effect of a positive correlation between union membership and workers satisfaction is possible. The theoretical prediction of the sign of the effect is ambiguous.

10. Tenure: The connection to the workplace probably increases with the time of employment in the firm. On the one hand, a longer employment duration also strengthens the identification with the job and the loyalty towards the employer, thus decreasing the probability of joining a union. On the other hand, unions already had more opportunities to recruit the employee for their organization. Overall, the sign of the impact of tenure is also ambiguous.

11. Firm size: Due to fix costs, average organizational costs decrease whit firm size. The opportunity for a "voice" option is also negatively correlated with the firm size. Larger companies often have a Work Council or Supervisory Board, both which benefit the activities and the acceptance of unions. The larger the firm the higher are the opportunities of rent–sharing between firms and unions in the goods markets and the greater the extent of wage bargaining in the labor market. For all these reasons, union activities and union density should be positively correlated with firm size.

12. Industry: Unions are traditionally strong in the manufacturing industry. In the public service, unions are accepted by employers, especially where the Social Democrats

are in office. In the growing private service sector, the establishment of unions is more difficult due to more rapid changes in the industry, less homogeneous interests of the employees, and a higher opposition of employers. The competition in goods and labor markets also varies over industries and more competition limits the possibility for rent sharing between firms and workers. Moreover, capital accumulation differs considerably between industries. A higher capital intensity causes a lower labor elasticity increasing the scope of union bargaining and union density. In addition, strong unions might give rise to a more capital intensive production.

4 Correlated Random Effects Probit Model

This section presents the econometric framework that we use in the empirical analysis. The goal is to estimate the probability of being a trade union member for employed workers. In order to take account of the panel structure of the data and to consider unobserved individual specific effects which might be correlated with the regressors, we estimate a correlated random effects probit model suggested by Chamberlain (1984). In the previous section, we discussed various variables as potential determinants of union membership. A number of these variables are likely to be correlated with unobserved individual characteristics thus suggesting the estimation of a random effects model allowing for such correlation. While it is beyond the scope of the analysis to explicitly model all endogeneous variables in the absence of a sufficient number of instruments, our approach takes account of the potential endogeneity of explanatory variables in a flexible way.

Consider the following multivariate probit model for individuals $i = 1, ..., N$ in periods $t = 1, ..., T$:

$$y_{it} = \begin{cases} 1 & \text{if } \tilde{y}_{it} \geq 0 \\ 0 & \text{else} \end{cases} \tag{1}$$

with $\tilde{y}_{it} = \beta x_{it} + c_i + u_{it}$. The distribution of $(u_{i1}, ..., u_{iT})$ conditional on $\{x_{i1}, ..., x_{iT}, c_i\}$ is multivariate normal with mean 0 and covariance matrix $\Sigma = (\sigma_{jk})$, $\{j, k = 1, \ldots, T\}$. We observe $(x_{i1}, ..., x_{iT}, y_{i1}, ..., y_{iT})$ for a large number of individuals, whereas c_i is not observable. The individual specific (fixed) effect c_i can be interpreted as individual characteristics such as motivation or attidudes towards life. It is assumed that these characteristics are correlated with past experience and future expectations and that they are stable at least over the sample period.

Based upon the distributional assumptions concerning the residuals $(u_{i1}, ..., u_{iT})$, we obtain the following probit model:

$$P(y_{it} = 1 | x_{i1}, ..., x_{iT}, c_i) = \Phi[\sigma_{tt}^{-1/2}(\beta x_{it} + c_i)] \tag{2}$$

where $\Phi(.)$ is the standard normal distribution function and σ_{tt} is the t^{th} diagonal element of Σ.

Because our panel consists of $T = 4$ years, there exists an incidental parameter problem if we want to estimate all the c_i. Therefore, we consider a correlated random effects estimator suggested by Chamberlain, which is based on the following linear specification for the distribution of c_i conditional on x_i:

$$c_i = \lambda_1 x_{i1} + ... + \lambda_4 x_{i4} + v_i \tag{3}$$

where the distribution of v_i conditional on $x_{i1}, ..., x_{i4}$ is $N(0, \sigma_v^2)$. Specification (3) implies a strong restriction, since the regression function $\mathrm{E}(c_i|x_{i1}, ..., x_{i4})$ is linear and we assume homoskedastic and normally distributed error terms. The resulting distribution for y_{it} conditional on $x_{i1}, \ldots, x_{i4}$ has a probit form:

$$P(y_{it} = 1|x_{i1}, ..., x_{i4}) = \Phi[\alpha_t(\beta x_{it} + \lambda_1 x_{i1} + ... + \lambda_4 x_{i4})] \tag{4}$$

with $\alpha_t = (\sigma_{tt} + \sigma_v^2)^{-1/2}$. Combining the 4 equations yields the following matrix of coefficients:

$$\begin{aligned} \Pi &= diag\{\alpha_1, ..., \alpha_4\}[\beta I_4 + \iota\lambda'] \\ &= \begin{pmatrix} \alpha_1(\beta_1 + \lambda_1) & \alpha_1\lambda_2 & \alpha_1\lambda_3 & \alpha_1\lambda_4 \\ \alpha_2\lambda_1 & \alpha_2(\beta_2 + \lambda_2) & \alpha_2\lambda_3 & \alpha_2\lambda_4 \\ \alpha_3\lambda_1 & \alpha_3\lambda_2 & \alpha_3(\beta_3 + \lambda_3) & \alpha_3\lambda_4 \\ \alpha_4\lambda_1 & \alpha_4\lambda_2 & \alpha_4\lambda_3 & \alpha_4(\beta_4 + \lambda_4) \end{pmatrix} \end{aligned} \tag{5}$$

where $\iota = (1, 1, 1, 1)'$, $\lambda = (\lambda_1, \lambda_2, \lambda_3, \lambda_4)'$, and $\alpha = (\alpha_1, \alpha_2, \alpha_3, \alpha_4)'$.

For the period–by–period probit regression of y_{it} on the set of regressors in all periods, we have

$$P(y_{it} = 1|x_{i1}, ..., x_{i4}) = \Phi(\pi_{t1} x_{i1} + \pi_{t2} x_{i2} + \pi_{t3} x_{i3} + \pi_{t4} x_{i4}). \tag{6}$$

Note that only time-varying regressors can be introduced as regressors for each period. The first step of the estimation procedure suggested by Chamberlain (1984) consists of estimating these period–by–period probit equations. Also note that with a sufficient number of time–varying regressors, it is possible to estimate the model with time–varying β coefficients.

The structural parameters β, α, and λ are then estimated in a second stage by a minimum–distance approach since the first stage π–parameters are functions of these structural parameters. As usual in a probit model, it is not possible to identify all scale parameters $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$. However, the ratios $\frac{\alpha_t}{\alpha_1}$, which satisfy the following nonlinear restrictions :

$$\frac{\alpha_t}{\alpha_1} = \frac{\pi_{tt} + \pi_{t1}}{\pi_{11} + \pi_{1t}} \qquad (t = 2, ..., T) \tag{7}$$

are identified, if $\beta + \lambda_1 + \lambda_t \neq 0$. We use the scale normalization $\alpha_1 \equiv 1$ in order to identify the parameters of interest.

The second stage of the minimum distance approach involves the minimization of

$$[vec(\hat{\Pi}) - f(\beta, \alpha, \lambda)]' W^{-1} [vec(\hat{\Pi}) - f(\beta, \alpha, \lambda)] \tag{8}$$

with respect to β, α, and λ, where α_1 is set equal to one, $vec(\hat{\Pi})$ is the vector of all elements in the estimated matrix $\hat{\Pi} = (\hat{\pi}_{j,k})$, $\{j, k = 1, \ldots, 4\}$, and $f(\beta, \alpha, \lambda)$ represents the corresponding vector of the elements of the matrix in equation (5). The weighting matrix W is the variance–covariance–matrix of $vec(\hat{\Pi})$ estimated in the first step.

As an innovation, we use a design–matrix bootstrap procedure in the first stage where we resample the entire observation vector for an individual. We then estimate cross–sectional probits for each year based on the resample. If at least one of the 4 nonlinear cross–sectional regressions do not converge we draw another resample and restart the regressions. Overall, we use 1000 valid resamples to construct a robust covariance matrix. We use this bootstrap procedure for the following reasons. First, the bootstrap is likely to provide a better estimate in finite samples since the conventional estimate is based on an asymptotic approximation for a nonlinear estimator. Second, by drawing the entire observation vector for a given individual when forming the resample, the estimated variance–covariance–matrix takes account of remaining individual specific autocorrelation in the error term. Note that such autocorrelation does not invalidate the consistency of the cross–sectional probit estimates or of the entire estimation approach. Third, by basing the resample estimates for all four cross–sections we can automatically estimate the potential covariance between the π–estimates for different periods.

5 Empirical Results

We estimate the probability of a union membership based on data from the German Socioeconomic Panel (GSOEP) for the years 1985, 1989, 1993, and 1998. The goal of the analysis is to investigate the stability over time. The data set and the variables used are described in detail in the appendix A. We construct an unbalanced panel of 6623 individuals. The composition of the sample is shown in tables 2 and 3. We estimate a correlated random effects probit model as presented in section 4. This estimator enables us to make use of the panel structure of the data and to take into account unobserved individual specific effects which might be correlated with the regressors. This way,

we identify the components of an unobserved individual fixed effect, which can be interpreted as a "long term" characteristic of the individual and "short term" impacts (λ's) of this fixed characteristic. Correlations between the cross–section estimates are considered explicitly by including also past and future values of time varying regressors. The variance–covariance matrix including the covariances between all coefficients in all years is obtained through a bootstrap procedure. Before analyzing the stability of the membership equation over time, we investigate which regressor variables are related to the individual specific effect, i.e. for which variables we find significant λ coefficients.

Applying a series of Wald tests of the hypothesis that the estimated λ's are jointly equal to zero suggests the following assessment of the variables used (here and in the following, we use a significance level of 5 %).

1. Variables unrelated to the individual specific effect:
   FEMALE, FOREIGNER, AGE, MARRIED, APPRENTICESHIP, ABITUR, UNIVERSITY, SEMI–SKILLED and SKILLED BLUE–COLLAR WORKER, WORKING PART–TIME, CHRISTIAN–DEMOCRAT, SATISFACTION, and industry dummies.

2. Variables related to the individual specific effect:
   EARNINGS, SOCIAL–DEMOCRAT, WHITE–COLLAR WORKER, CIVIL SERVANT, TENURE, and FIRM SIZE.

The results of the Wald tests are not reported here but are available on request. Note that the first group comprises also all time invariant regressor variables for which λ's cannot be estimated.

In order to characterize the changes over time, it is important to examine to what extent the variation in union membership is caused by changes in its determinants or by changes in the *impacts* of these determinants on union membership. In principle, there are two possibilities of time varying coefficients for a time variant regressor. First, the relationship with the individual specific effect can vary over time (λ's) as mentioned in the previous paragraph. Second, the direct impact of a ceteris paribus change of the regressor for a given individual (β's) can change over time. When investigating as to whether the propensity to be a union member is stable over time for an individual with given observed characteristics and given individual specific effect, we have to analyze the second possibility, i.e. to test for the stability of the β–coefficients over time. For all regressor variables displaying no significant variation of their year specific coefficients β we restrict the coefficient to be equal over time. In contrast to Fitzenberger et al. (1999), who found no statistical evidence for a variation of the estimated coefficients over time, our results indicate a small number of significant changes of coefficients across the considered years. We present results for three specifications of the union membership equation where specification 1 uses only personal characteristics as regressors, specification 2 involves those regressors available in the IABS data (i.e. the

prediction of the net union density NUD for the IABS is based on this specification), and specification 3 uses all available personal and firm characteristics as regressors, see section 3.

The set of regressors for the three specifications are the following (see tables 2 and 3 for the variable definitions):

- Specification 1: FEMALE, FOREIGNER, AGE, MARRIED, APPRENTICESHIP, ABITUR, UNIVERSITY, CHRISTIAN–DEMOCRAT, SOCIAL–DEMOCRAT, status as blue–collar or white–collar worker, PART–TIME, SATISFACTION, EARNINGS
- Specification 2: Sector affiliation, Firm size plus the same as specification 1 except for SATISFACTION, CHRISTIAN–DEMOCRAT, SOCIAL–DEMOCRAT
- Specification 3: Sector affiliation, Firm size plus the same as specification 1

In addition, all specifications include year specific dummy variables for missing values in earnings and satisfaction (only specification 1 and 3). The final versions of the preferred specifications are presented in table 6. They are the outcome of the following procedure. We estimate all specifications allowing for year specific β–coefficients for all regressor variables (having set λ to zero for all regressor variables where λ proves not significant). Based on this specification, we performed Wald tests regarding the stability over time of the β–coefficients for different regressor variables. The results of these tests can be found in table 7. The preferred final specifications in table 6 restrict all those coefficients to be constant over time for which table 7 does not show a significant test statistic.

The problem of endogeneity should not be very serious in our regressions. As already mentioned, a causal effect of union membership on earnings is hardly conceivable in Germany. Political orientation and satisfaction with work might be endogenous to some degree. These variables are excluded in our specification 2 used for the prediction of union density at the industry level based on the IABS. Furthermore, specification 2 is driven by the fact that the IABS only contains information if an employee is a white–collar worker or a blue–collar worker *or* if (s)he is part–time working. Since it is not possible to identify a part–time working white–collar worker or blue–collar worker the employee status variables in specification 2 correspond to this information.

We start with the interpretation of the results for specification 1 involving the individual's characteristics as determinants of union membership. A lower probability of a union membership for females and part–time workers corresponds to the theoretical expectations, see section 3. The negative sign of FOREIGNER seems to strengthen the conjecture that foreigners are less tied to the German labor market. The signs of the age variables indicate a concave impact of the age with a maximum at about 50 years. The education variables ABITUR and UNIVERSITY show the expected negative, but

mostly insignificant, impact, whereas an APPRENTICESHIP is positively, but also often not significantly, correlated with the probability of being a union member. Not surprisingly, preferences for the social–democratic party are positively correlated with union membership, whereas an orientation towards the christian–democratic party exhibits a negative, but insignificant sign.

Only for semi–skilled blue–collar workers in specification 1 and 2, we find the expected positive impact and for part–time workers the expected negative sign in all specifications. However, the empirical results indicate no clear significant relationship between being a blue–collar worker (interacted with skill level) and union membership. Some significant changes over time appear quite erratic and are difficult to interpret. Satisfaction with the job seems to be negatively correlated with the propensity to join a union, but only in specification 3 this relationship is highly significant. For gross earnings, we can not find any systematic impact. The other variables, which are also possible determinants of earnings, already seem to affect union membership decision. Firm size exhibits a significantly positive effect on union membership and, notably, the coefficients change significantly over time. These changes are not monotone but if anything then union membership in large firms seems to increase over time.

Summing up, we do not find significant and consistent changes in the β–coefficients over time which can explain the decline in union membership. If anything, the reported changes tend to go into the opposite direction.

6 Prediction of net union density based on IABS

For the purpose of predicting net union density (NUD) at the industry level, specification 2 discussed in the previous section includes only such variables that are also available in the IAB employment sample (IABS). Based on specification 2, we predict the individual probability of being a union member using about 3.1 million observations during the period 1985–1997 available in the IABS. Because of the quite good statistical fit of specification 2, the prediction here should be more accurate than the prediction in Fitzenberger et al. (1999) for an earlier time period. Lorenz and Wagner (1991) also predicted their empirical results based on the GSOEP data from 1985 for 29 industries using the corresponding average aggregate values at the industry level. In contrast, we are able to provide estimates for a longer period from 1985–1997 determining also the trend in NUD. In addition, our prediction is based on individual data capturing the distribution of characteristics within an industry in a better way. The estimated year specific β–coefficients can directly be used for the years 1985, 1989, and 1993. For the remaining years the coefficients in the two nearest years, for which estimation took place, are linearly interpolated. The prediction uses the available information in the IABS data to construct the individual specific effect. The correspondence between the industry information available in the IABS and the industry classification of the

GSOEP can be found in table 9.

After predicting the estimates for the individuals available in the IABS, we regressed the probability of being a union member on industry dummies for each year from 1985–1997. These regressions are computed as weighted OLS, where the single individual observation is weighted by the duration of employment in the corresponding year. Table 8 provides the estimated NUDs for 46 industries which are the dummy coefficients of the aforementioned regression.

Our results show that the estimated NUDs are fairly constant between 1985 and 1989. In most industries, the NUD is decreasing continuously between 1989 and 1997. In all industries the NUD is lower in 1997 than in 1985 (and in 1989). On average over the years considered, the NUD varies between 18.3 % in sector 34 (Music Instruments, Toys, Fountain Pens) and 57.8 % in sector 21 (Iron) in the manufacturing sector. In most of the non–manufacturing sectors, the NUDs are considerably lower on average with values between 9.6 % in sector 66 (Health and Veterinary) and 25.9 % in sector 55 (Ship Traffic, Waterways).

7 Conclusion

This paper analyzes union membership among employees in West Germany based on the German Socioeconomic Panel in the years 1985, 1989, 1993, and 1998. We estimate a correlated random effects probit model as suggested by Chamberlain (1984) to take proper account of individual specific effect. One specification of the estimated models is used to predict union density at the industry level based on the IAB employment subsample (IABS). Our results suggest that at the individual level the propensity to be a union member has not changed considerably over time. Therefore, the aggregate decline in membership is due to composition effects. We also find a strong decline of net union density at the industry level during the 1990's based on the predicted union membership for the IABS data, i.e. the composition effect is also strongly working within industries. Our results suggest that unions have not become more attractive for the types of workers who traditionally have a low propensity to be a union member and whose share has been increasing continuously over time. In order to stop the decline in aggregate union membership, unions would have to be much more successful in recruiting these types of workers.

A Data

Our analysis is based on the German Socioeconomic Panel (GSOEP), a representative random sample of German households, which covers the years 1984–1998. In the

initial random sample of households in 1984, foreign households in Germany were oversampled. Among other things, household members aged 16 or older are interviewed regarding demographic issues related to the interview year and questions concerning their working life and their value orientation. In addition to the basic questions each interview contains additional issues, ascertained not every year. Only in 1985, 1989, 1993, and 1998, one of these issues was membership in a trade union. Consequently, the empirical analysis is restricted to these years. We consider persons in gainful employment only, because our analysis is focusing on the determinants of union membership decision among employees and the determination of the share of unionized workers at the industry level (NUD). For comparability over time, only West Germans are included in the empirical analysis. The resulting sample consists of 6623 individuals for whom the relevant information is available at least for one of the four mentioned years. Over the different years, the number of observations varies between 3271 in 1998 and 4265 in 1989.

The remarkable decline of the share of union members and foreigners in 1998 may at least partly be caused by the high panel mortality in this year. During the period of observation the education level increases considerably. Whereas the average age of the participants in the SOEP is somewhat higher at the end of the period observed, workers' satisfaction is slightly decreasing over time. The earnings variable is defined as gross earnings in the last month in thousands of DM in prices of 1985. As can be seen in table 9 the 35 industries reported in the SOEP are grouped into the 17 industries used in the empirical analysis.

The IAB employment subsample (IABS ≡ "IAB–Beschäftigtenstichprobe") is a 1% random sample from German social security accounts. The new release of the IABS covering the years 1975–1997 has only recently been made available by the research institute of the Federal Employment Service ("Institut für Arbeitsmarkt– und Berufsforschung") in Nürnberg. In contrast to common survey data, the information contained in the IABS is highly reliable because the data are collected to calculate the pensions of retired people. The main features of the data set and a users' guide can be found in Bender et al. (1996).[4] Social security contributions are mandatory for employees who earn more than a minimum wage threshold ("geringfügige Beschäftigung") and who are working regularly. The main exceptions are governmental civil servants ("Beamte") and self–employed, who do not pay any social security contributions. Students who work less than 20 hours a week on a regular basis or less than 6 weeks full–time are also excluded from the mandatory contributions. About 80% of the German employees are covered by this mandatory pension system.

[4]This guide describes the first release of the IABS comprising the time period 1975 to 1990. The construction of the data set is basically the same for the two data sets. Further information about the newer version can also be found in Bender et al. (2000).

The basic information in the IABS consists of social security insurance spells comprising the starting point and the end of an employment spell, the average daily gross wage (excluding employers' contributions) and socioeconomic characteristics. To obtain monthly earnings, the daily wage is multiplied by 30. For our prediction, an annual wage observation is calculated as the weighted average of the wage observations for the individual across all spells in the same industry within one year where the spell length is used as the weight. With multiple spells (jobs) at the same time, cf. Bender et al. (1996, p.74), we take the sum of the daily wages across spells as the wage observation and treat the individual as full–employed. If an individual was employed in different industries within one year, the spells are grouped by industry. This means that several observations for the same person within a year are possible. The annual wage observations are then weighted by the total employment spell length as percentage of the whole year. High-skilled workers (with a technical college or university degree) are dropped from the data set, because wages above the upper social security threshold ("Beitragsbemessungsgrenze") are not reported reliably. The resulting sample consists of about 3.1 million observations during the period 1985–1997.

Table 2: Description of dummy variables

Dummy	equals 1
MEMBER	if observed person is a union member
FEMALE	for females
MARRIED	for married and cohabiting persons
FOREIGNER	for foreigners
Education:	
APPRENTICESHIP	if apprenticeship or a similar vocational training is the highest professional training degree
ABITUR	if the highest educational degree is "Abitur"
UNIVERSITY	if the highest educational degree is a technical college ("Fachhochschule") or a university degree
Party preferences:	
CHRISTIAN–DEMOCRAT	if the person feels close to the christian democratic party (conservatives)
SOCIAL–DEMOCRAT	if the person feels close to the social democratic party
Vocational status:	if observed person is
PART–TIME WORKING	... full–time working
SEMI–SKILLED	... unskilled or semi–skilled blue–collar worker
SKILLED	... skilled blue–collar worker
WHITE–COLLAR	... white–collar worker
Firm size:	for employees in firms with
...< 20	... less than 20 employees
...20 – 199	... 20 up to 199 employees

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Dummy	equals 1
...200 – 1999	... 200 up to 1999 employees
...≥ 2000	... more than 2000 employees
CIVIL SERVICE	... employed in the civil service
Industry	if the industry in which the person works is
SECTOR 01	... Agriculture, Forestry and Fisheries, Mining, Energy and Water Supply
SECTOR 02	... Chemical Products
SECTOR 03	... Synthetic Materials
SECTOR 04	... Stone and Earth Products
SECTOR 05	... Iron–, Steel– or Metal–Industry, Machinery and Vehicle Construction
SECTOR 06	... Electric Appliances and Precision Instruments
SECTOR 07	... Woodwork, Paper, Printing and Publishing
SECTOR 08	... Textiles and Apparel
SECTOR 09	... Food, Beverages and Tobacco
SECTOR 10	... Construction
SECTOR 11	... Trade
SECTOR 12	... Railways or Postal Services
SECTOR 13	... Other Transportation
SECTOR 14	... Credit and Insurance Companies
SECTOR 15	... Catering and Hotels, Private Households, Private Non–Profit Organizations, Public Sector (Government, Social Insurance) and Other Services
SECTOR 16	... Education and Science
SECTOR 17	... Healthcare System

Table 3: Description of other variables

Variable	description
AGE	Age of observed person divided by 10
AGE^2	AGE squared
EARNINGS	Total earnings last month in thousands of DM, constant prices (1985 = 100)
$EARNINGS^2$	EARNINGS squared
TENURE	Duration of employment in the current firm, in years
SATISFACTION	Satisfaction of the worker with his job, scaled from 0 (not satisfied) to 10 (very satisfied)

Table 4: Descriptive statistics of dummy variables

Variable	1985		1989		1993		1998	
	frequency	in %	frequency	in %	frequency	in %	frequency	in %
MEMBER	1080	29.9	1189	27.9	1001	27.1	717	21.9
FEMALE	1353	37.4	1685	39.5	1493	40.4	1357	41.5
MARRIED	2477	68.5	2745	64.3	2472	66.9	2096	64.1
FOREIGNER	1072	29.7	1262	29.6	1080	29.2	783	23.9
Education:								
APPRENTICESHIP	2201	60.9	2647	62.1	2362	63.9	2300	70.3
ABITUR	144	4.0	264	6.2	327	8.8	401	12.3
UNIVERSITY	239	6.6	299	7.0	308	8.3	408	12.5
Party preferences:								
CHRISTIAN–DEMOCRAT	665	18.4	824	19.3	448	12.1	366	11.2
SOCIAL–DEMOCRAT	1111	30.7	1276	29.9	804	21.8	809	24.7
Vocational status:								
PART–TIME WORKING	549	15.2	720	16.9	636	17.2	44	1.3
BLUE–COLLAR WORKER:								
SEMI–SKILLED	790	21.9	828	19.4	701	19.0	563	17.2
SKILLED	32	0.9	32	0.8	41	1.1	34	1.0
WHITE–COLLAR WORKER	1417	39.2	1773	41.6	1646	44.5	1766	54.0
CIVIL SERVICE	695	19.2	759	17.8	702	19.0	661	20.2
Firm Size:								
< 20	751	20.8	947	22.2	856	23.2	846	25.9
20–199	1021	28.2	1152	27.0	949	25.7	831	25.4
200–1999	878	24.3	1102	25.8	958	25.9	851	26.0
≥ 2000	964	26.7	1064	24.9	932	25.2	743	22.7
Sector:								
SECTOR 01	135	3.7	188	4.4	284	7.7	294	9.0
SECTOR 02	145	4.0	153	3.6	167	4.5	149	4.6
SECTOR 03	63	1.7	84	2.0	55	1.5	32	1.0
SECTOR 04	67	1.9	58	1.4	36	1.0	35	1.1
SECTOR 05	695	19.2	878	20.6	649	17.6	456	13.9
SECTOR 06	253	7.0	357	8.4	227	6.1	181	5.5
SECTOR 07	128	3.5	152	3.6	130	3.5	92	2.8
SECTOR 08	128	3.5	146	3.4	94	2.5	49	1.5
SECTOR 09	150	4.2	150	3.5	108	2.9	81	2.5
SECTOR 10	330	9.1	321	7.5	310	8.4	220	6.7
SECTOR 11	355	9.8	396	9.3	402	10.9	431	13.2
SECTOR 12	58	1.6	52	1.2	53	1.4	27	0.8
SECTOR 13	90	2.5	108	2.5	107	2.9	127	3.9
SECTOR 14	120	3.3	163	3.8	154	4.2	173	5.3
SECTOR 15	569	15.7	694	16.3	519	14.0	505	15.4
SECTOR 16	146	4.0	134	3.1	151	4.1	147	4.5
SECTOR 17	182	5.0	231	5.4	249	6.7	272	8.3
Number of Observations	3614		4265		3695		3271	

Table 5: Statistics of other variables

		1985	1989	1993	1998
AGE	Mean	38.00	37.65	39.03	39.22
(in years)	Std.dev.	11.54	11.90	11.49	10.56
	Min.	17	17	17	19
	Max.	65	65	65	65
EARNINGS	Mean	2637	2862	3117	3327
(DM per month	Std.dev.	1374	1592	1740	1861
in 1985 prices)	Min.	0	0	96	0
	Max.	15000	25962	31461	23041
TENURE	Mean	9.77	9.73	10.68	9.89
	Std.dev.	8.32	8.77	9.04	9.06
	Min.	0	0	0	0
	Max.	44	46	50	50
SATISFACTION	Mean	7.57	7.25	7.10	7.01
	Std.dev.	2.09	2.01	1.97	1.93
	Min.	0	0	0	0
	Max.	10	10	10	10

Table 6: Estimation results – Correlated Random Effects Probit

Coefficient	Year	Specification		
		(1)	(2)	(3)
CONST		-2.4770***	-2.8926***	-2.6389***
		(0.241)	(0.243)	(0.262)
FEMALE		-0.1210**	-0.1884***	-0.1216**
		(0.054)	(0.055)	(0.055)
FOREIGNER	1985		-0.1396**	
			(0.636)	
	1989		-0.3436	
		-0.6681	(0.611)	-0.1122**
	1993	(0.050)	-0.0655	(0.050)
			(0.064)	
	1998		-0.2529***	
			(0.064)	
AGE		0.3092***	0.3371***	0.3249***
		(0.082)	(0.091)	(0.093)
AGE^2		-0.0313***	-0.0338***	-0.0377***
		(0.009)	(0.011)	(0.011)
MARRIED		-0.0312	-0.0451	-0.0630
		(0.044)	(0.047)	(0.047)

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Coefficient	Year	Specification (1)	(2)	(3)
CHRISTIAN–DEMOCRAT		-0.0698	—	-0.0265
		(0.052)		(0.057)
SOCIAL–DEMOCRAT		0.0718**	—	0.1119***
		(0.031)		(0.034)
APPRENTICESHIP		0.0519	0.0853*	0.0666
		(0.045)	(0.045)	(0.045)
ABITUR		-0.1606**	-0.0545	-0.1501*
		(0.082)	(0.088)	(0.086)
UNIVERSITY	1985		-0.0373	
			(0.129)	
	1989		0.0061	
		-0.2162**	(0.113)	-0.0063
	1993	(0.093)	0.0813	(0.095)
			(0.109)	
	1998		-0.2499**	
			(0.111)	
SEMI–SKILLED BLUE–COLLAR WORKER	1985			0.2063***
				(0.075)
	1989			-0.0643
		0.0828*	0.1456***	(0.070)
	1993	(0.050)	(0.053)	0.2842***
				(0.080)
	1998			0.0460
				(0.090)
SKILLED BLUE–COLLAR WORKER		-0.0065	0.2642	0.0847
		(0.213)	(0.218)	(0.227)
WHITE–COLLAR WORKER	1985			0.0411
				(0.074)
	1989			-0.0919
		-0.0364	-0.0205	(0.067)
	1993	(0.041)	(0.052)	0.1398**
				(0.065)
	1998			0.0725
				(0.075)
CIVIL SERVICE		—	0.1422**	0.1382**
			(0.061)	(0.062)
PART–TIME WORKING		-0.3853***	-0.3317***	-0.2966***
		(0.059)	(0.066)	(0.069)
SATISFACTION		-0.0098	—	-0.0185**
		(0.007)		(0.008)
EARNINGS	1985			-0.0568
				(0.060)

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Coefficient	Year	Specification (1)	(2)	(3)
	1989			0.0197
		0.0257	-0.0406	(0.053)
	1993	(0.031)	(0.034)	-0.0251
				(0.043)
	1998			-0.0425
				(0.041)
EARNINGS^2	1985			0.0027
				(0.008)
	1989			-0.0047
		-0.0062*	-0.0010	(0.007)
	1993	(0.003)	(0.003)	-0.0035
				(0.004)
	1998			-0.0011
				(0.004)
TENURE		—	—	0.0020
				(0.005)
FIRM SIZE	1985	—	0.3357***	0.3289***
20–199			(0.074)	(0.085)
	1989	—	0.2978***	0.3071***
			(0.068)	(0.080)
	1993	—	0.2442***	0.2320***
			(0.068)	(0.083)
	1998	—	0.3977***	0.4184***
			(0.079)	(0.094)
FIRM SIZE	1985	—		0.3735***
200–1999				(0.086)
	1989	—		0.3224***
			0.3814***	(0.086)
	1993	—	(0.063)	0.3729***
				(0.088)
	1998	—		0.4022***
				(0.091)
FIRM SIZE	1985	—	0.3850***	0.4046***
$\geq$ 2000			(0.074)	(0.089)
	1989	—	0.3779***	0.4046***
			(0.069)	(0.091)
	1993	—	0.3858***	0.3872***
			(0.070)	(0.089)
	1998	—	0.4759***	0.5107***
			(0.079)	(0.097)
SECTOR 02		—	0.1449*	0.0709
			(0.086)	(0.089)

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Coefficient	Year	Specification (1)	(2)	(3)
SECTOR 03		—	-0.0820	-0.0783
			(0.112)	(0.109)
SECTOR 04		—	-0.0150	-0.0417
			(0.146)	(0.143)
SECTOR 05		—	0.2849***	0.2482***
			(0.050)	(0.050)
SECTOR 06	1985	—	-0.2279**	-0.1483*
			(0.099)	(0.087)
	1989	—	-0.3445***	-0.3209***
			(0.092)	(0.084)
	1993	—	-0.2209**	-0.1145
			(0.105)	(0.100)
	1998	—	0.1609	0.0201
			(0.119)	(0.101)
SECTOR 07		—	0.1867*	0.0987
			(0.098)	(0.099)
SECTOR 08		—	0.1682	0.2562**
			(0.108)	(0.114)
SECTOR 09		—	-0.0484	-0.0048
			(0.106)	(0.102)
SECTOR 10		—	-0.2803***	-0.3624***
			(0.084)	(0.086)
SECTOR 11		—	-0.1171*	-0.1137
			(0.068)	(0.071)
SECTOR 12	1985	—	1.0477***	
			(0.220)	
	1989	—	0.9847***	
			(0.191)	0.8703***
	1993	—	1.0875***	(0.167)
			(0.190)	
	1998	—	0.7551***	
			(0.206)	
SECTOR 13		—	-0.0791	-0.0922
			(0.100)	(0.098)
SECTOR 14		—	-0.3788***	-0.2709**
			(0.115)	(0.112)
SECTOR 15		—	-0.1475**	-0.1821***
			(0.059)	(0.059)
SECTOR 16		—	-0.2102*	-0.1027
			(0.111)	(0.108)
SECTOR 17		—	-0.4345***	-0.4377***
			(0.109)	(0.111)

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Coefficient	Year	Specification (1)	(2)	(3)
α	1989	1.0349***	1.0251***	1.0454***
		(.041)	(.0345)	(.047487)
	1993	1.0275***	.9840***	1.01173***
		(.046)	(.0411)	(.0523)
	1998	1.0731***	1.0028***	1.0084***
		(.058)	(.0461)	(.0569)
$\lambda_{EARNINGS}$	1985	.0812***	.036406***	-.719978E-02
		(.0636)	(.069084)	(.069006)
	1989	.3760***	.316600***	.250588***
		(.0710)	(.073010)	(.074604)
	1993	.0186***	-.04224***	-.052744***
		(.0505)	(.055690)	(.052017)
	1998	.1865***	.219964***	.181576***
		(.0439)	(.046414)	(.048122)
$\lambda_{EARNINGS^2}$	1985	-.865545E-03***	.157870E-02 ***	.012688 ***
		(.997658E-02)	(.010473)	(.010399)
	1989	-.048948 ***	-.047278 ***	-.03586 ***
		(.981892E-02)	(.010428)	(.010717)
	1993	.105319E-02***	.306723E-02 ***	-.278657E-03***
		(.541703E-02)	(.595004E-02)	(.558145E-02)
	1998	-.014635 ***	-.015401***	-.012771 ***
		(.424500E-02)	(.432960E-02)	(.430330E-02)
$\lambda_{WHITE-COLLAR}$	1985	-.123902***	-.087790***	-.136326***
		(.064619)	(.067188)	(.066737)
	1989	-.187868***	-.187549***	-.221675***
		(.066741)	(.074323)	(.069247)
	1993	-.064190***	-.165185***	-.144594***
		(.068868)	(.076844)	(.073582)
	1998	-.121708***	-.110550***	-.176727***
		(.066979)	(.067638)	(.072736)
$\lambda_{SOCIAL-DEMOCRAT}$	1985	.082700***	—	.140406***
		(.054686)		(.050890)
	1989	.157362***	—	.169309***
		(.060187)		(.056210)
	1993	.101737***	—	.031627***
		(.061017)		(.061384)
	1998	.205703***	—	.257539***
		(.055829)		(.057592)
$\lambda_{FIRM\ SIZE20-199}$	1985	—	.136432***	.158727 ***
			(.070558)	(.069391)
	1989	—	.169901***	.262790 ***
			(.073186)	(.073291)

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Coefficient	Year	Specification (1)	(2)	(3)
	1993	—	.235614***	.223318 ***
			(.086371)	(.085739)
	1998	—	-.161325***	-.230342***
			(.088101)	(.086234)
$\lambda_{FIRM\ SIZE200-1999}$	1985	—	.388755***	.281453 ***
			(.078687)	(.078828)
	1989	—	.246569***	.386364 ***
			(.080137)	(.080796)
	1993	—	.126669***	.101398 ***
			(.082776)	(.085485)
	1998	—	.022978***	-.015826*
			(.081444)	(.086694)
$\lambda_{FIRM\ SIZE\geq2000}$	1985	—	.371683 ***	.296972 ***
			(.083884)	(.083989)
	1989	—	.461777 ***	.531305 ***
			(.086256)	(.089421)
	1993	—	.242391 ***	.248481 ***
			(.093663)	(.096458)
	1998	—	-.176953***	-.237742***
			(.091472)	(.095571)
$\lambda_{CIVIL\ SERVICE}$	1985	—	.162532***	.179336 ***
			(.081787)	(.078522)
	1989	—	-.578834E-03	-.025583***
			(.087361)	(.088830)
	1993	—	-.293504***	-.341095***
			(.092761)	(.089356)
	1998	—	.381668 ***	.420545 ***
			(.085450)	(.082523)
λ_{TENURE}	1985	—	—	.019793 ***
				(.476239E-02)
	1989	—	—	-.014059 ***
				(.454028E-02)
	1993	—	—	.301885E-02***
				(.381814E-02)
	1998	—	—	.512082E-02***
				(.322674E-02)
Number of Obs.	1985	3115	3042	3000
	1989	3118	3045	3003
	1993	3118	3044	3002
	1998	3119	3045	3003

* , ** , *** mark significant coefficients to the 10%, 5%, 1% level; standard errors in parentheses.

[a]: If a coefficient is restricted to be constant over time there is no year information. In addition, all specification include year specific dummy variables for missing values in the earnings and the satisfaction (only specification 1 and 3) variables.

Table 7: Results of Wald tests for time variability of estimated coefficients

Variable	Specification (1)	(2)	(3)
CONST	1.8391	3.0454	3.1103
	(0.606)	(0.385)	(0.375)
FEMALE	0.8778	6.0600	5.4996
	(0.831)	(0.109)	(0.139)
FOREIGNER	6.3483	8.8271	5.2608
	(0.096)	(0.032)	(0.154)
AGE, AGE^2	5.0144	4.6275	6.2120
	(0.542)	(0.592)	(0.400)
MARRIED	2.5813	2.0514	3.0191
	(0.461)	(0.562)	(0.389)
PARTY PREFERENCES	4.3657	—	6.7787
	(0.627)		(0.342)
APPRENTICESHIP	4.4692	3.7697	7.4955
	(0.215)	(0.287)	(0.058)
ABITUR, UNIVERSITY	6.3204	15.2224	12.0014
	(0.388)	(0.018)	(0.062)
BLUE–COLLAR/	8.8908	6.4671	18.4404
WHITE–COLLAR WORKER	(0.447)	(0.692)	(0.030)
PART–TIME WORKING	4.6641	2.3507	6.9346
	(0.198)	(0.503)	(0.074)
SATISFACTION	4.9129	—	0.8141
	(0.178)		(0.846)
EARNINGS, $EARNINGS^2$	7.7489	10.7364	14.0308
	(0.257)	(0.097)	(0.029)
TENURE	—	—	5.8984
			(0.117)
FIRM–SIZE	—	16.8936	21.7201
		(0.050)	(0.010)
CIVIL SERVICE	—	1.9562	1.9562
		(0.582)	(0.582)
SECTOR	—	49.1123	46.6824
		(0.428)	(0.527)

χ^2–test–statistics with P-values in paranthesis

Table 8: Estimates of annual net union density for 46 industries

Industry		year												
No.	Description	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
06	Electricity, Gas, Heat and Water	.444	.452	.464	.478	.493	.465	.437	.411	.387	.367	.362	.358	.352
10	Mining	.535	.552	.572	.600	.624	.597	.575	.559	.538	.510	.509	.511	.511
14	Chemical Products	.441	.438	.434	.434	.432	.420	.411	.404	.397	.379	.367	.363	.354
15	Petroleum Processing	.445	.427	.431	.433	.436	.420	.408	.407	.401	.388	.379	.364	.356
16	Synthetic Materials	.283	.278	.274	.276	.276	.264	.256	.252	.252	.245	.232	.223	.213
17	Rubber Products	.369	.366	.362	.366	.366	.353	.341	.333	.334	.314	.301	.300	.290
18	Stone and Earth Products	.282	.277	.277	.276	.278	.269	.260	.254	.248	.250	.237	.227	.217
19	Fine Ceramics	.336	.330	.329	.333	.331	.322	.312	.311	.309	.296	.281	.272	.260
20	Glass and Products	.373	.375	.373	.376	.375	.360	.347	.341	.339	.324	.315	.314	.307
21	Iron	.584	.589	.602	.610	.612	.597	.590	.584	.581	.553	.546	.543	.524
22	Non–Ferrous Metals	.496	.495	.494	.492	.485	.468	.457	.452	.453	.435	.418	.412	.406
23	Foundry	.492	.488	.492	.496	.494	.478	.468	.464	.462	.448	.424	.416	.404
24	Fabricated Metal Products	.402	.400	.396	.395	.392	.380	.369	.365	.359	.350	.336	.326	.312
25	Steel, Light Metal and Tracked Vehicles	.397	.391	.390	.390	.387	.374	.365	.356	.349	.349	.337	.324	.308
26	Machinery	.474	.468	.466	.467	.462	.448	.438	.433	.429	.422	.408	.399	.392
27	Office and Data Processing Machines	.260	.243	.227	.214	.203	.201	.202	.210	.209	.270	.239	.204	.179
28	Vehicles and Repairs	.515	.512	.510	.511	.510	.498	.482	.475	.470	.457	.444	.435	.424
29	Shipbuilding	.539	.545	.552	.550	.561	.554	.537	.536	.532	.524	.512	.487	.487
30	Air and Space	.500	.495	.492	.489	.485	.478	.474	.473	.471	.442	.418	.413	.415
31	Electric Appliances and Repairs	.276	.261	.251	.243	.233	.233	.235	.242	.249	.324	.291	.263	.232
32	Precision and Optical Instruments	.226	.213	.205	.195	.190	.190	.194	.195	.199	.276	.243	.212	.183
33	Iron, Sheet Metal and Metal Products	.255	.244	.235	.226	.216	.216	.215	.220	.229	.317	.282	.250	.218
34	Music Instruments, Toys, Fountain Pens	.192	.181	.177	.172	.162	.158	.159	.168	.173	.252	.223	.194	.164
35	Woodwork	.338	.336	.336	.333	.331	.322	.314	.310	.305	.306	.294	.285	.275
36	Wood Processing	.338	.336	.336	.333	.332	.322	.314	.310	.305	.306	.294	.285	.275
37	Pulp, Paper and Board	.417	.412	.406	.408	.408	.394	.381	.379	.378	.378	.365	.356	.342
38	Paper and Products	.417	.412	.405	.408	.408	.394	.381	.379	.378	.378	.365	.355	.342
39	Printing and Publishing	.349	.344	.342	.339	.337	.325	.317	.312	.310	.314	.304	.295	.283
40	Leather	.313	.311	.312	.314	.312	.305	.296	.290	.284	.274	.259	.247	.231
41	Textiles	.364	.362	.365	.368	.368	.356	.346	.343	.339	.331	.315	.301	.286
42	Apparel	.285	.283	.282	.285	.285	.280	.274	.271	.268	.271	.254	.233	.217
43	Food	.219	.216	.214	.212	.214	.208	.202	.200	.198	.195	.184	.176	.164
44	Beverages	.306	.298	.296	.296	.293	.288	.282	.280	.275	.280	.265	.251	.242
45	Tobacco	.299	.298	.301	.297	.295	.285	.284	.281	.278	.268	.259	.255	.264
46	Construction	.200	.198	.197	.197	.196	.189	.183	.179	.174	.174	.165	.156	.148
50	Trade	.143	.138	.135	.133	.129	.127	.126	.125	.123	.125	.118	.110	.102
54	Railways	.772	.769	.765	.765	.764	.762	.749	.740	.738	.656	.672	.641	.660
55	Ship Traffic, Waterways	.272	.270	.264	.275	.278	.267	.265	.263	.262	.247	.241	.239	.219
56	German Postal	.702	.694	.689	.683	.669	.669	.659	.661	.659	.570	.571	.554	.566

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Industry		year												
No.	Description	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	Services													
57	Other Transportation	.230	.226	.224	.223	.221	.213	.205	.202	.200	.198	.185	.175	.165
60	Credit Institutions	.123	.118	.114	.111	.107	.105	.103	.102	.102	.099	.095	.092	.090
61	Insurance Companies	.123	.118	.114	.111	.107	.105	.103	.102	.102	.099	.095	.092	.090
64	Catering and Hotels	.127	.126	.126	.125	.124	.122	.120	.118	.117	.113	.104	.095	.086
65	Educations, Research and Culture	.150	.144	.140	.137	.134	.129	.125	.122	.120	.111	.107	.100	.093
66	Health and Veterinary	.119	.113	.109	.107	.103	.100	.096	.093	.091	.082	.080	.076	.073
67	Other Services	.131	.127	.126	.124	.123	.121	.121	.120	.118	.112	.108	.102	.096

Table 9: Industry Classification in SOEP and National Accounts

No.[a]	Industry	SOEP[b]	NA[c]
01	Agriculture and Forestry	01	01
01	Fisheries	02	01
01	Energy and Water Supply	03	06
01	Mining	04	10
02	Chemical Products	05	14,15
03	Synthetic Materials	06	16,17
04	Stone and Earth Products	07	18–20
05	Iron and Steel	08	21,24,25,33
05	Machinery and Vehicle Construction	09	26,28–30
06	Electric Appliances and Precision Instruments	10	27,31,32,34
07	Woodwork, Paper, Printing and Publishing	11	35–39
08	Textiles and Apparel	12	40–42
09	Food, Beverages and Tobacco	13	43–45
10	Construction	14	46
10	Building extension and conversion	15	46
11	Wholesale Trade	16	50
11	Commercial Mediation	17	50
11	Retail Trade	18	50
12	Railways	19	54
12	Postal Services	20	56
13	Other Transportation	21	55,57
14	Credit Institutions	22	60
14	Insurance Companies	23	61
15	Catering and Hotels	24	64
15	Personal Services	25	67
15	Cleaning and Waste Disposal	26	67
15	Legal Advice, Immovables	29	67
15	Other Services	30	67
15	Private Non–Profit Organizations	31	67
15	Private Households	32	67
15	Government	33	67
15	Social Insurance	34	67
15	Other Industries	35	67
16	Education and Science	27	65,70
17	Healthcare System	28	66

[a]: Industry classification used in the empirical analysis.
[b]: Industry classification used in the SOEP data set.
[c]: Industry classification used in the National Accounts of the German Statistical Office ("Statistisches Bundesamt", FS 18, R 1.3).

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