

# Educational Mismatch and Labour Market Institutions: The Role of Gender

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# Educational Mismatch and Labour Market Institutions: The Role of Gender\*

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**Abstract:** Using the German Socio-Economic Panel data, we investigate the correlation between trade union membership and educational mismatch. Employing panel tobit and probit regressions, we find that union membership is negatively associated with overeducation, primarily among males. This finding remains consistent across subgroups of full-time or private sector male workers, as well as for males of all ages or residing in either East or West Germany. The same negative correlation is observed for females younger than the median age and residing in East Germany. Our results indicate that collective wage agreements and works councils do not drive this relationship. Conversely, no significant correlation is found between union membership and undereducation.

**Keywords:** Educational mismatch; Gender; German Socio-Economic-Panel; Trade union membership

**JEL Classification:** I21, J24, J51

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## 1 Introduction

Educational mismatch is a widespread phenomenon, which can impose substantial costs on workers, firms, and society (e.g., Tsang and Levin, 1985). Accordingly, the determinants of overeducation and, to a lesser extent, undereducation have been investigated comprehensively. The pertinent analyses have analyzed sociodemographic factors such as gender (e.g., McGoldrick and Robst, 1996; Santiago-Vela and Mergener, 2022), and migration background (e.g., Akgüç and Parasnis, 2023; Aleksynska and Tritah, 2013) as well as educational aspects, such as grades, college quality or the field of study (e.g., Robst, 1995; Turmo-Garuz and Bartual-Figueras, 2019). Other studies have investigated job characteristics (Büchel and Pollmann-Schult, 2004; Di Pietro and Cutillo, 2006; Green and McIntosh, 2007) and labour market composition (e.g., Davia et al., 2017; Tarvid, 2015).

In contrast, the effects of labour market institutions on educational mismatch have scarcely been looked at. This is surprising because institutional constraints can alter the consequences of educational mismatch and the costs and gains of achieving its desired degree. In the context of labor market institutions, particularly trade unions, there is evidence that employees benefit from improved employment outcomes, such as an increased likelihood to engage in work-related training (e.g., Green et al., 1999). This higher level of training has been linked to an enhanced probability of successful job applications (e.g., Thurow, 1975), and a decreased likelihood of overeducation (e.g., Büchel and Pollmann-Schult, 2004; Di Pietro and Cutillo, 2006). Apart from these mechanisms, the improved bargaining power or employment protection provided by such institutions may also increase individuals' chances of promotion within their current workplace or in external job applications. Labor market institutions are, therefore, significant factors in determining one's job prospects and educational match.

While some studies examining educational (mis)match have included covariates accounting for labour market institutions such as trade union density or union membership (e.g., Belfield, 2010; McGoldrick and Robst, 1996; Sharma and Sharma, 2017; Sloane et al., 1999, 1996), to the best of our knowledge none has examined the relationship in detail yet. The present study fills that gap and investigates the relationship between an employee's trade union membership and educational mismatch for Germany. Being a union member can provide individuals with superior information about educational requirements, the wage costs of overeducation, possible wage gains in case of undereducation, and employer behaviour. In consequence, union members are better able to obtain their preferred extent of educational match than non-members. We extend our analysis and scrutinise whether the linkage is affected by two of the central pillars of industrial relations in Germany, namely collective

bargaining and co-determination.

Using data from the German Socio-Economic Panel (SOEP) we show that trade union membership is negatively related to the likelihood of overeducation as well as the years of overeducation. Dividing the analyses by gender reveals that this negative effect is mainly due to the male subsample. We employ several robustness checks regarding the methodological approach which produce confirmatory results. Furthermore, heterogeneity analyses reveal that the relationship between union membership and overeducation hold for the subsamples of full-time working males and males working in the private sector as well as for males of all ages and living in East and West Germany. For females such negative correlation can be found in the subsamples of younger women, as well as women living in East Germany. Using additional information on the presence of collective wage bargaining agreements and works councils does not alter our results. In contrast to overeducation, no relationship is discernible regarding undereducation.

The paper proceeds by providing some background information on industrial relations in Germany and deriving hypotheses about the impact of union membership on educational mismatch in Section 2. Section 3 reviews related analyses, while Section 4 describes the data and explains the empirical approach. We describe and discuss our findings in Section 5 and subsequently provide some concluding remarks in Section 6.

## 2 Background

In this section, first, we describe the industrial relations system in Germany, with a special focus on trade unions and their members, collective bargaining and co-determination. Second, we derive a number of hypotheses relating to the effect of union membership on various elements of educational mismatch.

### 2.1 Industrial Relations in Germany

In Germany, currently about 16% of all employees belong to a trade union. This fraction has declined substantially, from a peak of about 36% just after re-unification in 1990 (OECD and AIAS, 2021). Less than 40% of all union members are female and union density among men exceeds the density among females by a factor of about 1.5. This male dominance has slightly declined over the last decades, during a period featuring a substantial increase in female labour force participation.<sup>1</sup>

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<sup>1</sup>The male preponderance is underlined by the fact that the German Trade Union Confederation (*Deutscher Gewerkschaftsbund*; DGB), an umbrella organisation representing around six million members, elected its first ever female president in 2022. Moreover, only one of the heads of its eight member unions is female.

Union members in Germany generally pay a (tax-deductible) membership fee of 1% of their gross wage income. In exchange, they receive financial support in case of a strike, legal advice and support in employment-related conflicts. In addition, trade unions provide members with information about working conditions and job-related issues. Members can also benefit from financial advantages, such as reduced insurance contribution rates.

In contrast to other countries (see the surveys by Bryson (2014) and Fang and Hartley (2022)), there is no robust evidence of wage differences between union members and non-members in Germany, once observable characteristics of employees are taken into account (Fitzenberger et al., 1999; Goerke and Pannenberg, 2004; Schmidt and Zimmermann, 1991). A major reason is that union membership is not directly linked to collective bargaining.<sup>2</sup> This can already be observed when comparing the bargaining coverage of about 40% in the private sector in 2021, respectively almost 90% in the public sector (Ellguth and Kohaut, 2022), to union density. From a legal perspective, collective bargaining agreements apply to all firms covered by the contract and union members who work in the covered firm. However, in the vast majority of cases, firms pay all employees, irrespective of their union membership status, the negotiated wage.<sup>3</sup> In addition to negotiations at the industry level, there is also firm-level bargaining. In 2021, about 9% of all employees were paid according to such contracts. Firms not subject to collective agreements can negotiate wages and working conditions individually with their staff. However, in about 50% of the relevant contracts, pay is aligned to a collective agreement (Ellguth and Kohaut, 2022).

Collective bargaining agreements usually set wages for well-defined groups of employees. These pay-scales are described in terms of tasks, on-the-job training, formal qualifications and sometimes aspects such as tenure. Additionally, collective agreements settle, for example, working time regulations, fringe benefits and overtime remuneration.

While (sectoral) collective bargaining constitutes one of the main pillars of the German system of industrial relations, co-determination represents the second such cornerstone (Jäger et al., 2022). Works councils can be established in private-sector firms with at least 5 employees and require a vote by the workforce. Since such a vote is not compulsory, councils exist in less than 10% of all eligible private-sector establishments. As this is the case mostly in large firms, about 40% of all private-

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<sup>2</sup>Bonaccolto-Töpfer and Schnabel (2023) present evidence suggesting a union membership wage premium of about 2.5%, with substantial variations across occupations, using two recent waves of the SOEP.

<sup>3</sup>According to Hirsch et al. (2022) somewhat less than 10% of employees working in firms covered by a collective bargaining agreement are not paid according to it. Their data does not contain information about union membership.

sector employees are employed in firms with a works council. Personnel councils, the public-sector equivalent, are much more widespread than works councils.

## 2.2 Union Membership and Educational Mismatch

Overeducation is associated with a number of detrimental outcomes, such as lower job satisfaction (e.g. Battu et al., 1999; Iseke, 2014; Verhaest and Verhofstadt, 2016), a decrease in wages relative to employees of the same qualification who exhibit no educational mismatch (e.g. Duncan and Hoffman, 1981; Korpi and Tåhlin, 2009; Sicherman, 1991), and a deterioration in health (e.g. Bracke et al., 2013; Korpi and Tåhlin, 2009). In consequence, we assume that employees desire to leave a job for which they are overeducated. If overeducation arises or persists because employees do not find a better suited job, it will be more likely to occur if they lack information about how to attain a better position, alternative jobs or possibly the full scope of the adverse consequences of overeducation.

Trade unions in Germany provide members with job-related information, such as required levels of qualifications or associated wages and benefits. Moreover, union members are argued to take a more active stance in social exchanges and union membership is hypothesised to provide more social contacts (Flavin et al., 2010; Flavin and Shufeldt, 2016; Keane et al., 2012; Radcliff, 2005). Greater social capital can also result in better information about working conditions and educational requirements.<sup>4</sup> Therefore, we hypothesise that trade union membership reduces overeducation on account of its informational advantages.

Even if employees know about their overeducation and its adverse consequences, obtaining a job with a better educational match may be difficult, especially if firms benefit from employing overeducated individuals (see e.g. Sloane et al. (1996)). First, employees have to voice their desire for a job change. Second, they have to realise their aspirations. If trade unions act as a voice for employees, union members in particular are better able to communicate their desire to avoid overeducation than non-members. Moreover, if union members are better protected against management reprisals in case of voicing discontent, for example, because they are less likely to face a dismissal (see Berglund and Furåker (2016); Freeman (1980); Goerke and Pannenberg (2011); Ivlevs and Veliziotis (2017) and Pierse and McHale (2015)), they are more likely to express the ambition to obtain a better job match. In consequence, we hypothesise that trade union membership reduces overeducation because union members can state a desire to leave a situation of overeducation at

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<sup>4</sup>This line of reasoning is consistent with evidence that the risk of overeducation (overqualification) is lower for individuals with highly educated fathers or individuals from high status families (Capsada-Munsech, 2015; Erdsiek, 2016; Turmo-Garuz and Bartual-Figueras, 2019; Verhaest and Omey, 2010), because they might provide their children with better information regarding their labour market integration, as well as with higher social capital in the form of work-related networks.

lower expected costs than non-members.<sup>5</sup>

Finally, leaving overeducation necessitates that an employee implements the required change. If this entails an employer change, union members may be more willing to undertake such a step because they know more about its potentially beneficial consequences. If escaping overeducation necessitates a job change within the firm, union membership may provide employees with a better bargaining position in negotiations with the employer. This bargaining effect can arise since unions can support their members in negotiations with their employer by providing legal information, advice and representation. Accordingly, the above line of reasoning suggests that trade union membership reduces overeducation because it lowers the expected costs of avoiding educational mismatch.

We summarise our considerations in

### **Hypothesis 1**

Trade union members are less likely to be overeducated than comparable non-members and exhibit lower levels of overeducation.

The correlates of undereducation are less well-established than those of overeducation. There is some evidence that undereducated employees obtain higher wages than comparably educated individuals who exhibit no educational mismatch (Kiker et al., 1997; Verdugo and Verdugo, 1989; Verhaest and Omey, 2012). This suggests that undereducated individuals have to invest less in their formal education to receive the same expected returns than adequately educated employees. Therefore, employees may benefit from undereducation (Sloane et al., 1996). If that is the case, the same mechanisms which help trade union members to avoid or leave situations of overeducation, could assist them in acquiring a position for which they are inadequately educated.

We expect the correlation between union membership and undereducation to be weaker than the relationship to overeducation. By promoting undereducation, trade unions would indirectly undermine the system of pay-scales which make wage determination less arbitrary.

The above reasoning gives rise to

### **Hypothesis 2**

a) Trade union members are more likely to be undereducated than comparable non-members and exhibit higher levels of undereducation.

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<sup>5</sup>Sloane et al. (1999) argue that trade unions may entice employers to change job specifications and recruiting behaviour to reduce educational mismatch. Such effect would have the same consequences as lower costs of requesting a better match.

b) The correlation between undereducation and trade union membership is weaker than the link between overeducation and membership.

Educational mismatch is defined as the presence of over- or undereducation. If the impact of union membership on overeducation is more pronounced than on undereducation, as Hypothesis 2b claims, we can state

### **Hypothesis 3**

Trade union members are more likely to be educationally matched than comparable non-members.

The above reasoning assumes that trade union membership affects all employees equally. However, there is some evidence of gender differences in the probability of being over- or undereducated (Belfield, 2010; Diem, 2015; Ordine and Rose, 2009). Moreover, the consequences of educational mismatch can be gender-specific as females are, for example, more affected by the overeducation pay penalty (Mavromaras et al., 2012; Voon and Miller, 2005). This suggests that the gains from and costs of educational mismatch may also depend on gender. In addition, there is some evidence that females are less successful in achieving pay rises or promotions (Artz et al., 2018). If this feature also applies to educational mismatch, we can expect females to be less likely to leave such a situation than males. Finally, the dominance of males in the German union movement could imply that unions provide greater support to male members, for example, to avoid situations of overeducation. In consequence, we formulate

### **Hypothesis 4**

The impact of trade union membership on educational mismatch is more pronounced for males than females.

The above considerations have focused on trade union membership. If working conditions are regulated by a collective agreement, they will be more formalised and less likely to be at the management's discretion or affected by an employee's preferences than in the absence of such an agreement. This is the case because pay-scales are usually described in great detail in such collective agreements, inter alia, defining the educational requirements for a job. Moreover, any employment contract resulting in over- or undereducation of an employee is more likely to violate contractual obligations than in the absence of a collective agreement. Consequently, it becomes more difficult for a firm to hire or employ someone who is inadequately educated for a job (see Lammers et al. (2022) for a comparable expectation). Thus, we summarize



### **Hypothesis 5**

- a) Collective bargaining in the establishment reduces educational mismatch.
- b) The impact of trade union membership on educational mismatch is mitigated by collective bargaining.

A similar line of reasoning applies to employees who work in establishments in which there is a works council (in the private sector) or a personnel council (in the public sector). These councils have co-determination rights relating to hiring decisions, dismissals and also internal job changes. Therefore, they can limit the extent of employer induced educational mismatch. Moreover, works and personnel councils can help employees avoid situations of educational mismatch, particularly those of overeducation. Therefore, we expect educational mismatch to be less pronounced in the presence of a works or personnel council. This, in turn, implies that the impact of individual trade union membership on educational mismatch is likely to be smaller. Accordingly, we state

### **Hypothesis 6**

- a) A works or personnel council in the establishment reduces educational mismatch.
- b) The impact of trade union membership on educational mismatch is mitigated in establishments having a works or personnel council.

## **3 Previous Contributions**

To the best of our knowledge, there is no thorough investigation of the impact of an individual's trade union membership on educational mismatch. Previous analyses mostly include an indicator of union membership as one of many right-hand-side variables, without discussing it in detail.

In one of the first pertinent contributions, McGoldrick and Robst (1996) consider the United States and use the 1985 wave of the PSID. The sign of the correlation between overeducation and trade union membership varies with the measure of overeducation. Wald and Fang (2008) use the 1999 wave of the Canadian Workplace and Employee Survey (WES). While the percentage of overeducated union members is much lower than that of non-members, the probability of overeducation is not significantly correlated with an indicator of union membership.<sup>6</sup>

Turning to Australia, Fleming and Kler (2008) consider the first wave of HILDA. Their focus is on the relationship between overeducation and job satisfaction. Flem-

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<sup>6</sup>Wald and Fang (2008) do not distinguish between individual union membership and bargaining coverage. This is likely to be the case in McGoldrick and Robst's (1996) study, as well.

ing and Kler (2008), *inter alia*, present findings with overeducation as dependent variable and report a positive correlation with union membership. Mavromaras et al. (2009) use the same data and indicate that severe overskilling is more frequent among trade union members.

There is also some evidence on the relationship between union membership and educational mismatch for the UK. Sloane et al. (1999, 1996) use data for a small number of British labour markets from the mid 1980s and separately consider males and females. They report correlations with union membership which are mostly insignificant. Belfield (2010) employs the 2004 sweep of WERS and shows that the probability of overeducation tends to be higher among union members than non-members in the private, but not in the public sector.

In sum, studies for Anglo-Saxon labour markets suggest either no or a positive correlation between trade union membership and overeducation. These findings contrast with the results by Sharma and Sharma (2017) for India who report significant negative relationships between membership and over- as well as undereducation.

In addition to country-specific studies, the determinants of educational mismatch have been considered using cross-country data. Aleksynska and Tritah (2013) focus on immigrants in 22 European countries using ESS data between 2002 and 2009. They provide evidence for a positive relationship between trade union membership and overeducation and a negative linkage with undereducation for the native born population, though not for immigrants. Finally, there are studies which consider correlations between educational mismatch and union density (Aleksynska and Tritah, 2013; Davia et al., 2017) or collective bargaining coverage (Jacobs et al., 2021).

## 4 Data and Methodology

To estimate the correlation between trade union membership and educational mismatch, we use data from the SOEP (version 37) (DIW, 2022), a representative longitudinal study on households and individuals living in Germany. The survey has been carried out annually since 1984 (Goebel et al., 2019). Until 1989, the year prior to German reunification, the data only includes inhabitants from West Germany.

### 4.1 Educational Mismatch

We employ the so-called statistical approach to measure over- and undereducation. It is based on the idea that the average level of formal education in a particular occupation indicates its required level. Employees whose years of education exceed or fall short of this average by at least one standard deviation are classified as over-

educated or undereducated, respectively (Verdugo and Verdugo, 1989).

Compared to other indicators of educational mismatch, such as the indirect self-assessment or the job analyst measure, the statistical approach is advantageous because it allows for the evaluation of an individual’s position in comparison to others in the respective reference group (Capsada-Munsech, 2019). In consequence, it assesses educational mismatch based on labour market demand and supply mechanisms, in line with the conceptualization of overeducation by Freeman (1976). Furthermore, the statistical measure automatically adjusts to changes in the labour market and job requirements (Capsada-Munsech, 2019). Finally, the statistical approach implies a restrictive classification of over- and undereducation, as it usually results in a larger proportion of matched individuals than the alternative measures (Blásquez and Budría, 2012).

One of the difficulties in assessing educational mismatch is accounting for changes in educational requirements for jobs and participation in higher education over time.<sup>7</sup> Therefore, we follow Verdugo and Verdugo (1989) and use the mean years of education,  $\bar{x}_{ot}$ , within an occupation  $o$ , in each survey year,  $t$ , as a benchmark. Thus, we define

$$\bar{x}_{ot} = \frac{1}{I_{ot}} \sum_i^{I_{ot}} x_{it}, \quad (1)$$

where  $I_{ot}$  denotes the number of individuals working in occupation  $o$  in survey year  $t$  and  $x_{it}$  years of education of individual  $i$ .

To define an occupation  $o$ , we utilise the ISCO classification based on the question *“What is your current position/occupation?”*. Following Blásquez and Budría (2012), we transform the 4-digit variable into a 3-digit classification to define the reference group. The years of education,  $x_{it}$ , are extracted from the variable *“Number of years of education”*.

We define an individual as overeducated if  $x_{it} > \bar{x}_{ot} + s_{ot}$  and as undereducated if  $x_{it} < \bar{x}_{ot} - s_{ot}$ , where  $s_{ot}$  denotes the standard deviation of education years of individuals in occupation  $o$  in survey year  $t$ . An individual who is neither over- nor undereducated belongs to the group of educationally matched employees. Therefore, employees for whom  $x_{it} < \bar{x}_{ot} + s_{ot}$  holds are either undereducated or matched and, thus, not classified as overeducated, while those characterised by  $x_{it} > \bar{x}_{ot} - s_{ot}$  are not undereducated and, consequently, either overeducated or educationally matched. Finally, we employ two quantitative measures of educational mismatch. Years of overeducation are given by  $x_{it} - \bar{x}_{ot} - s_{ot}$  if this difference is positive (and zero otherwise). If the difference  $x_{it} - \bar{x}_{ot} + s_{ot}$  is negative, we define years of undereducation

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<sup>7</sup>The educational expansion is substantial in Germany. Official labour market data shows an increase in higher education graduates from 227,525 in 1998 to 517,944 in 2021 (Statistisches Bundesamt, 2021b). The SOEP data indicate that average years of education rose from 10.4 in 1985 to 12.84 in 2019 (see Figure 1 in Appendix A).

as the absolute value of this expression. If the expression is non-negative, years of undereducation are zero.

## 4.2 Independent Variables

Our main independent variable stems from the question "*Are you a member of one of the following organisations or confederations?*". The first option listed is *trade union*, giving respondents the choice to tick either a yes-box or a no-option.<sup>8</sup> From the responses, we construct a dummy variable, which takes the value of one if an employee belongs to a trade union, and zero otherwise. The questionnaire contains the relevant information in the survey years 1985 and 1989 for the western part of the country and, after reunification, in 1993, 1998, 2001, 2003, 2007, 2011, 2015 and 2019 for respondents throughout Germany.<sup>9</sup>

We include a number of further independent variables which are commonly employed in analyses of educational mismatch (see e.g. Caroleo and Pastore, 2018; Groot and Maassen van den Brink, 2000; Turmo-Garuz and Bartual-Figueras, 2019). The first set focuses on personal characteristics. In particular, we include a dummy equalling one if the respondent is female, a categorical measure of migration status,<sup>10</sup> variables describing the respondent's age and age squared (divided by 100) and dummy variables indicating civil status.<sup>11</sup> As educational mismatch may be related to childcare responsibilities (e.g. Green and McIntosh, 2007; Groot, 1996; Sloane et al., 1999), we control for the number of children. Moreover, the estimations contain dummy variables indicating the federal state of residence.

The second set of independent variables relates to job- or work-related aspects. Specifically, we include dummy variables for being a white collar worker and a civil servant, for having experienced unemployment, having a permanent contract, being a full-time employee, as well as firm-size dummies (4 categories), and tenure

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<sup>8</sup>The question stems from the questionnaire in 2019. It constitutes the translation of the German text by the authors since the one provided by the SOEP is imprecise. Note that the wording of the question and the list of organisations or confederations vary somewhat over time. The option *trade union* was always included.

<sup>9</sup>Although union membership is assessed in 1990 for the East sample, the analyses do not include this year due to insufficient data on the confounding factors.

<sup>10</sup>See e.g. Aleksynska and Tritah (2013); Joonas et al. (2014). We differentiate between direct migrants who immigrated to Germany themselves, indirect migrants who were born in Germany, while their parents came from abroad, and a third (reference) group of individuals without any migration background.

<sup>11</sup>We differentiate individuals living together in any kind of relationship, such as marriage or registered partnership, individuals living separately, for example, due to divorce, while the reference group is formed of those who indicate that they have never been in a registered relationship, marriage or comparable, which we will refer to as singles.

(measured in years) and tenure squared (divided by 100).<sup>12</sup>

In addition to these job-related variables, which are available in each year with union membership information, some of these SOEP waves contain questions concerning collective bargaining and works or personnel councils. From this information we construct dummy variables taking the value of one if the respondent states that their wage is paid according to a collective wage agreement (for the years 2015 and 2019) or works in an establishment in which there is a works or personnel council (for the years 2001, 2011, and 2019).

### 4.3 Sample Restrictions

We restrict our sample to the years in which union membership information is available. Moreover, we focus on employed individuals and exclude self-employed, solo-self-employed and all respondents exceeding their legal retirement age. Finally, we drop all individuals with missing values. This leaves us with a sample of 62,445 observations from 31,679 individuals for our main estimations.

Table 1 reports descriptive statistics for selected variables (see Table 9 in Appendix B for a complete documentation). About 46% of the observations stem from females. Respondents are on average 42 years old. The majority lives in some kind of registered partnership, has no migration background, works full-time, in a white collar job, and has a permanent contract. Around one quarter of the sample works in the public sector, while 5.8% are civil servants. Approximately one third has experienced unemployment. On average, individuals have worked for the same company for almost 11 years.

### 4.4 Estimation Approach

As years of over- and undereducation are censored at zero from below, we estimate random effects Tobit models (Tobin, 1958).<sup>13</sup> Our estimation equation reads:

$$Y_{it0} = \beta_1 + \beta_2 TUM_{it} + \beta_3 X'_{it} + \lambda_t + \eta_m + \gamma_o + \xi_s + \nu_i + \epsilon_{it} \quad (2)$$

$Y_{it0}$  measures years of under- and overeducation.  $TUM_{it}$  equals one if a respondent  $i$  belongs to a trade union in year  $t$ , and  $\beta_2$  is the coefficient of interest.  $X'_{it}$  is a vector containing personal and job- and work-related controls. We include year and month dummies  $\lambda_t$  and  $\eta_m$ .  $\gamma_o$  captures occupation effects, while  $\xi_s$  represents industry fixed effects.  $\nu_i$  includes the individual random effects which are assumed

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<sup>12</sup>Replacing tenure by labour market experience does not affect the results reported in Section 5.2.

<sup>13</sup>Estimations are executed with STATA version 17, which allows for the application of random effects tobit models in panel settings using the command `xttobit` with the specification `ll` for left-censored data and `ul` for right-censored data.

Table 1: Descriptive Statistics

	mean	sd	min	max
Trade Union	0.207	0.405	0	1
Gender	0.458	0.498	0	1
Direct migrant	0.130	0.337	0	1
Indirect migrant	0.040	0.195	0	1
No migrant	0.830	0.376	0	1
Age	42.221	11.215	17	65
Single	0.288	0.453	0	1
Married/ Partner	0.581	0.494	0	1
Seperate/ Widowed	0.131	0.338	0	1
Number of Kids	1.312	1.139	0	12
White Collar	0.614	0.487	0	1
Civil Servant	0.058	0.234	0	1
Public Sector	0.262	0.440	0	1
Prior Unemployment	0.325	0.468	0	1
Permanent	0.911	0.285	0	1
Full-time	0.759	0.428	0	1
Tenure	10.791	10.2	0	50.9
Firm Size: < 20	0.214	0.410	0	1
Firm Size: 20 - 200	0.286	0.452	0	1
Firm Size: 200 - 2000	0.237	0.425	0	1
Firm Size: > 2000	0.263	0.441	0	1
N	62,134			

SOEP weights applied. Minimum and maximum indicators rounded to one decimal place.

to be independent and identically distributed (i.i.d.),  $N(0, \sigma_\nu^2)$  and  $\epsilon_{it}$  is the error term, which is assumed to be i.i.d.  $N(0, \sigma_\epsilon^2)$  and independent of  $\nu_i$ .

When we analyse the existence of educational mismatch, we estimate:

$$Prob(Y_{it} = 1) = \Phi(\beta_1 + \beta_2 TUM_{it} + \beta_3 X'_{it} + \lambda_t + \eta_m + \gamma_o + \xi_s + \nu_i + \epsilon_{it}), \quad (3)$$

where  $Y_{it}$  refers to individual  $i$  in occupation  $o$  being over- or undereducated in year  $t$ .

## 5 Results

In Section 5.1, we document various indicators of educational mismatch, distinguishing between trade union members and non-members and paying special attention to gender and institutional details. This provides first evidence on our five hypotheses. Section 5.2 presents estimation results, focussing on the role of gender. In Section 5.3, we consider the correlation for various subgroups. These sections provide comprehensive evidence concerning Hypotheses 1 to 4. Section 5.4 focuses on Hypothesis

5 and 6 and contains findings from subsamples, which enable us to analyse the two pillars of the German industrial relations system.

## 5.1 Descriptive Evidence

Table 2: Summary statistics of selected variables by union membership

	All		TUM = 0		TUM = 1		t-test
	mean	sd	mean	sd	mean	sd	
Years UE	0.094	0.375	0.095	0.381	0.090	0.352	-0.005
Years OE	0.161	0.604	0.169	0.620	0.128	0.537	-0.0411***
UE	0.103	0.305	0.103	0.304	0.106	0.308	0.003
OE	0.135	0.342	0.143	0.350	0.103	0.304	-0.0401***
Matched	0.762	0.426	0.754	0.431	0.791	0.407	0.0368***
N	62,134		50,035		12,099		

Years of undereducation measured in absolute terms. SOEP weights applied.  
\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 3: Summary statistics selected variables by union membership and gender

	Males					Females				
	TUM = 0		TUM = 1		t-test	TUM = 0		TUM = 1		t-test
	mean	sd	mean	sd		mean	sd	mean	sd	
Years UE	0.101	0.391	0.094	0.362	-0.007	0.090	0.370	0.083	0.331	-0.007
Years OE	0.170	0.611	0.128	0.542	-0.0423***	0.168	0.630	0.128	0.527	-0.0398***
UE	0.109	0.312	0.107	0.309	-0.002	0.096	0.295	0.104	0.305	0.008
OE	0.150	0.357	0.098	0.297	-0.0520***	0.137	0.344	0.115	0.319	-0.0220***
Matched	0.741	0.438	0.795	0.404	0.0540***	0.767	0.423	0.781	0.413	0.0144*
N	23,724		7,915			26,311		4,184		

Years of undereducation measured in absolute terms. SOEP weights applied. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 2 indicates that members of a trade union exhibit about 1.5 months of overeducation on average ( $= 0.128 \times 12$ ), while the respective number for non-members equals 2 months. Moreover, the probability of being overeducated is about 4 percentage points lower for union members than non-members. The probability of being educationally matched is 3.7 percentage points higher for union members. Finally, we observe no association between union membership and undereducation. Therefore, the descriptive evidence is consistent with Hypotheses 1, 2b and 3. Furthermore, Table 3 indicates that the differences in means concerning overeducation between union members and non-members exist for males and females, and are greater in magnitude for the former. This evidence is consistent with Hypothesis 4.

Table 11 in Appendix B shows that educational mismatch is lower in the presence of collective bargaining than its absence, while the reverse tends to be the case with regard to works councils. Moreover, the union membership effect only exists in the presence of collective bargaining, but not for uncovered employees. Similarly, the membership effects tends to be stronger in establishments with a works council than

in those without such institution. Therefore, the descriptive evidence is consistent with Hypothesis 5a, but not in line with Hypotheses 5b, 6a and 6b.

## 5.2 Main Findings

Table 4 depicts the estimated coefficients for the union membership dummy with years of undereducation (in columns 1 and 2) and overeducation (in columns 3 and 4) as outcome variables for panel random effects Tobit specifications. Columns 1 and 3 refer to specifications with no control variables other than month and year fixed effects, while columns 2 and 4 contain results from models including the entire set of covariates.<sup>14</sup>

Table 4: Panel RE tobit regressions

Years of...	(1) Undereducation	(2) Undereducation	(3) Overeducation	(4) Overeducation
Full sample				
Trade Union	-0.0302 (0.0232)	-0.0172 (0.0263)	-0.261*** (0.0396)	-0.148*** (0.0334)
<i>N</i>	62,445	62,445	62,445	62,445
Male subsample				
Trade Union	-0.0585* (0.0309)	-0.00345 (0.0346)	-0.313*** (0.0507)	-0.227*** (0.0473)
<i>N</i>	31,802	31,802	31,802	31,802
Female subsample				
Trade Union	0.000760 (0.0367)	-0.0298 (0.0405)	-0.181*** (0.0634)	-0.0378 (0.0477)
<i>N</i>	30,643	30,643	30,643	30,643
Years of undereducation measured in absolute terms. Columns (1) and (3) present the baseline results including month and year fixed effects. Columns (2) and (4), in addition, include the personal and job related covariates, as well as industry and occupation fixed effects. Standard errors in parentheses. * $p < 0.10$ , ** $p < 0.05$ , *** $p < 0.01$				

In the full sample, trade union membership is associated with a reduction in overeducation by -0.148 years. We observe no relationship for undereducation. These results mask substantial gender differences since we detect no significant correlations for female respondents once we control for personal and job related covariates. For males, the negative correlation between union membership and educational mismatch is quantitatively stronger than in the full sample indicating that trade union membership is related to 0.227 less years of overeducation.<sup>15</sup>

To ascertain the robustness of our main results, based on the statistical approach,

<sup>14</sup>Table 12 in Appendix B contains the full set of results for specifications 2 and 4.

<sup>15</sup>The model's re-estimation considering the East sample's 1990 data and excluding employment contract permanency from the covariates yields comparable results. The results can be provided upon request.



we have estimated equation (2) for alternative measures of educational mismatch (see Table 14 in Appendix C.1). We obtain qualitatively the same results regarding years of overeducation. Considering undereducation, we observe a positive correlation with trade union membership for males. Thus, our main finding of a negative correlation between union membership and years of overeducation in the full and the male sample is a robust result, while the observed correlation between union membership and years of undereducation is more sensitive with regard to the indicator of educational mismatch.

It could be argued that the results presented above are subject to reverse causality. In this case, individuals with more years of overeducation would be less likely to become union members. To mitigate such concerns, we have re-estimated equation (2) and replaced  $Y_{it0}$  as dependent variable by  $Y_{it+10}$  and  $Y_{it+20}$ . Therefore, the extent of over- and undereducation is related to the union membership status one or two years before.

As can be seen from columns (1) and (2) of Table 5, union membership in year  $t$  is not associated with years of undereducation at  $t + 1$  and  $t + 2$ . The earlier results for overeducation are also confirmed. Therefore, taking into account a time dimension does not indicate that reverse causality may be an issue.

Table 5: Panel RE tobit regressions on lead variables

	(1)	(2)	(3)	(4)
Years of...	Undereducation		Overeducation	
	t+1	t+2	t+1	t+2
Male subsample				
Trade Union	-0.00842 (0.0438)	0.0484 (0.0499)	-0.171*** (0.0526)	-0.159*** (0.0590)
$N$	34,379	27,318	29,461	22,886
Female subsample				
Trade Union	-0.0182 (0.0523)	0.0214 (0.0598)	-0.0270 (0.0621)	-0.120 (0.0738)
$N$	31,870	24,371	27,338	20,330

Years of undereducation are measured in absolute terms. Columns (1) to (4) include the full set of covariates. In columns (2) and (4), we cannot take into account those interviewed in 2019, as SOEP version 37 only contains information up to 2020. Standard errors in parentheses.  
\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

We next present results for the probability of being educationally (mis-) matched. Table 6 depicts marginal effects for the likelihood of undereducation (column 1), overeducation (column 2), and being educationally matched (column 3) as outcomes

from panel random effects probit specifications.<sup>16</sup> Union membership is associated with a 1.48 percentage point lower probability of overeducation and a 1.94 percentage point higher probability for being matched for the full sample. The marginal effects are stronger for the male subsample. For females, no linkage between membership and educational mismatch is discernible. We have also estimated bivariate probit and multinomial logit specifications (see Table 15 in Appendix C.2). The results for the full sample and the subsample of male respondents are qualitatively the same as depicted in Table 6. For females, some of the marginal effects become marginally significant.

Table 6: Panel RE probit: Average marginal effects

	(1)	(2)	(3)
	Undereducated	Overeducated	Matched
Full sample			
Trade Union	-0.00205 (0.00328)	-0.0148*** (0.00334)	0.0194*** (0.00517)
<i>N</i>	62,445	62,445	62,445
Male subsample			
Trade Union	-0.000580 (0.00446)	-0.0214*** (0.00489)	0.0215*** (0.00679)
<i>N</i>	31,802	31,802	31,802
Female subsample			
Trade Union	-0.00259 (0.00487)	-0.00242 (0.00295)	0.00900 (0.00798)
<i>N</i>	30,643	30,643	30,643

Columns (1) to (3) include the full set of covariates. Standard errors clustered at individual level and presented in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The picture we obtain from estimations with either years of educational mismatch or the probability of such states as left-hand side variables is broadly compatible with that derived from descriptive evidence. Years of overeducation and the probability of being overeducated are lower for union members than non-members. Moreover, the probability of being educationally matched is higher among union members. We observe qualitatively the same correlations for male union members as we do for the full sample. For females, we see no systematic correlation between union membership status and educational mismatch. These findings are consistent with Hypotheses 1, 2, and 3 for male employees. For females, our results essentially reject all three hypotheses. This, in turn, implies that the impact of trade union membership on all facets of educational mismatch is more pronounced for males

<sup>16</sup>To account for a potential non-linearity of the relationship between trade union membership and educational mismatch, we additionally regressed union membership on a categorical measure of educational mismatch ranging from "1- undereducated by more than 3 years" to "9 - overeducated by more than 3 years" and found similar results.

than for females, as claimed in Hypothesis 4.

### 5.3 Heterogeneity

Section 5.2 documents a striking difference in the association between trade union membership and educational mismatch between males and females. This may be due to different employment patterns. In Germany, the fraction of females working in the public sector substantially exceeds the percentage of females in the private sector (Statistisches Bundesamt, 2021a).<sup>17</sup> Moreover, the share of females working part-time exceeded 35% in Germany in 2021, and was much higher than the OECD-average, in comparison to about 10% for males (see OECD, 2022b). In addition, labour force participation of older females is markedly lower than of younger women and the substantial increase in participation has taken place particularly in the last two or three decades (OECD, 2022a). Finally, female labour force participation in East Germany was traditionally much and still is somewhat higher than in the western part of the country (Statistisches Bundesamt, 2022). Therefore, the gender differences revealed in Section 5.2 may be due to different employment patterns between males and females along these lines.

Accordingly, we have estimated panel random effects Tobit regressions for the years of under- and overeducation, separated by gender, for the public and private sector, for full- and part-time employees, for East and West Germany, and for older and younger employees, defined as being above or below the median age of 42 years (see Tables 16 to 19 in Appendix D).

For males, the results regarding years of overeducation reported in Table 4 can qualitatively also be observed for private sector employees, full-time employees, both age groups, and individuals living in East and West Germany. In addition, a negative and significant correlation between union membership and years of undereducation is observed in the subgroup of younger males. For females, there is no correlation discernible between trade union membership and undereducation for any of the subgroups. With regard to overeducation, female union members have significantly fewer years of such educational mismatch than comparable non-members if they are younger than the median observation. The correlation for females living in East Germany is weakly significant and negative, and slightly smaller than for males. All other estimated coefficients are insignificant.

In sum, the basic findings for the complete samples of males and females can also be observed in sufficiently large subsamples and provide further support for Hypotheses 1, 3, and 4. Moreover, the differential correlation between trade union membership and educational mismatch for females and males in Germany is unlikely

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<sup>17</sup>In 2021, 57.84% (2.95 mill.) of all public sector employees were female (Statistisches Bundesamt, 2021a)

to be due to differential employment patterns. The results for younger females may imply that the gender differences vanish in the future.

#### 5.4 The Role of Collective Bargaining and Works Councils

Tables 7 and 8 contain findings for - smaller - subsamples in which information about union membership and additionally either collective bargaining coverage (waves 2015, 2019) or the existence of a works council (waves 2001, 2011, 2019) is available. Columns 1 and 2 depict the estimated union membership coefficients for the respective subsamples without including the additional covariate, while columns 3 and 4 refer to the extended specifications. Comparing column 1 with column 3, as well as 2 with 4, indicates that the union membership effect is at most altered quantitatively, but never qualitatively, by adding information about institutional features of the German industrial relations system.

Table 7: Panel RE tobit regressions: Sample with information on collective wage bargaining

	(1)	(2)	(3)	(4)
Years of ...	Undereducation	Overeducation	Undereducation	Overeducation
Full sample				
Trade Union	-0.0774 (0.0642)	-0.264*** (0.0826)	-0.0864 (0.0647)	-0.194** (0.0835)
Collective Wage			0.0464 (0.0416)	-0.316*** (0.0532)
<i>N</i>	14,110	14,110	14,110	14,110
Male subsample				
Trade Union	-0.0858 (0.0815)	-0.463*** (0.102)	-0.117 (0.0821)	-0.392*** (0.103)
Collective Wage			0.170*** (0.0579)	-0.302*** (0.0698)
<i>N</i>	7,493	7,493	7,493	7,493
Female subsample				
Trade Union	-0.0442 (0.0978)	0.171 (0.106)	-0.0292 (0.103)	0.213* (0.109)
Collective Wage			-0.0875 (0.0580)	-0.199*** (0.0651)
<i>N</i>	6,617	6,617	6,617	6,617

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. Columns (1) and (2) present the baseline regression results on years of under- and overeducation for the restricted sample of the years 2015 and 2019. Columns (3) and (4), in addition, include a dummy equalling 1 if the respondent states that their wage is paid according to a collective wage agreement. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Focussing on the sample with information about collective bargaining coverage, we observe that the signs and significance levels of the estimated coefficients in columns 1 and 2 of Table 7 and columns 2 and 4 of Table 4 are the same. Therefore,

Table 8: Panel RE tobit regressions: Sample with information on existence of works councils

	(1)	(2)	(3)	(4)
Years of ...	Undereducation	Overeducation	Undereducation	Overeducation
Full sample				
Trade Union	-0.0408 (0.0451)	-0.157** (0.0642)	-0.0352 (0.0451)	-0.170*** (0.0646)
Council			-0.0566 (0.0435)	0.101* (0.0605)
<i>N</i>	25,361	25,361	25,361	25,361
Male subsample				
Trade Union	0.0331 (0.0590)	-0.176** (0.0824)	0.0320 (0.0592)	-0.190** (0.0831)
Council			0.0119 (0.0609)	0.110 (0.0824)
<i>N</i>	12,508	12,508	12,508	12,508
Female subsample				
Trade Union	-0.143** (0.0715)	-0.0310 (0.0981)	-0.132* (0.0718)	-0.0421 (0.0987)
Council			-0.123* (0.0634)	0.0959 (0.0867)
<i>N</i>	12,853	12,853	12,853	12,853

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. Columns (1) and (2) present the baseline regression results on years of under- and overeducation for the restricted sample of the years 2001, 2011 and 2019. Columns (3) and (4), in addition, include a dummy controlling for the existence of an works council in one's company. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

our main findings can also be observed in the two most recent waves of the SOEP with information about trade union membership.<sup>18</sup> Moreover, we find no correlation between union membership and undereducation. Male members exhibit fewer years of overeducation than non-members. The estimated coefficient for union membership for males declines from -0.46 to -0.39 when incorporating information about collective bargaining. This is consistent with Hypothesis 5b. Finally, we observe a negative correlation between bargaining coverage and overeducation, as stated above in Hypothesis 5a, and a positive relationship with undereducation in the male subsample.

In the sample with information about the existence of a works council (see Table 8), we observe comparable results as in the larger sample with the exception of undereducation among females. The estimated coefficients for union status on years of overeducation increase for all samples when including the council dummy, as the comparison of columns 2 and 4 in Table 8 shows.

<sup>18</sup>Incidentally, this equivalence suggests that the possible existence of a union membership wage premium, as diagnosed by (Bonaccolto-Töpfer and Schnabel, 2023) for 2015 and 2019, does not affect our results concerning educational mismatch.

To sum up: Collective bargaining is mostly associated with lower educational mismatch, though not with respect to undereducation among males. Works councils do not seem to be associated in a systematic manner with educational mismatch. Moreover, taking into account information about collective bargaining or works councils does not affect the findings concerning trade union membership. Therefore, there is no indication of an omitted variable bias. With respect to Hypotheses 5a and 5b, most of our results are consistent with both parts when looking at collective bargaining. In the case of works councils, Hypotheses 6a and 6b can be rejected.

## 6 Conclusion

Educational mismatch is widespread and can have severe consequences, both for individuals and society. Nonetheless, the effects of labour market institutions on over- and undereducation have received relatively little attention. In this paper, we focus on trade unions and, more specifically, union membership in an industrial relations setting in which no closed-shops and free-riding on the benefits of union activities is common. We hypothesise that union membership can help individuals to avoid or shorten adverse states of educational mismatch because union members have better information and face lower expected costs of leaving such situations. We test our hypotheses for Germany, using data from the SOEP for a period of almost 4 decades. We obtain robust evidence for males that union membership and educational mismatch are correlated negatively, while there is some evidence of a positive association with undereducation. Both results are compatible with the view that unions provide private gains to their members because the adverse consequences of educational mismatch are reduced, while possible positive consequences are enhanced. For females, the observed correlations are quantitatively markedly smaller and often not significantly different from zero. Taking into account the effects of collective bargaining and co-determination does not qualitatively alter these results.

To illustrate the quantitative importance of the effects, the subsequent back-of-envelope calculation may be informative. From Table 2 we know that 13.5% of respondents are overeducated and that the duration of overeducation in the whole sample, in which undereducated and educationally matched individuals exhibit zero years of overeducation by definition, is 0.161 years. Therefore, each overeducated respondent has on average an (uncompleted) duration of overeducation of about 1.2 ( $=0.161/0.135$ ) years. Union membership is associated with a reduction in the duration of overeducation by 0.15 years, that is, by 12.5%. Suppose, the private costs of overeducation amount to 5% of the annual gross wage (e.g., Chu Ng, 2003). For a union member these costs would be more than 0.6% ( $5\% \times 0.125$ ) lower, given

a tax-deductible membership fee of 1% of the gross wage. Therefore, reducing the adverse consequences of educational mismatch can constitute a strong incentive to become member of a trade union.

If overeducated employees become aware of these benefits, they may decide to join a trade union. Hence, we cannot completely rule out the possibility that the chain of causation is not from membership to educational mismatch, but vice versa. However, we believe that this is unlikely to be the case: First, in Section 5.2 we also document findings from a specification in which educational mismatch is related to union membership a year or two earlier. Second, our findings of a negative correlation would suggest that those who are less overeducated join a trade union, and there seems to be no plausible rationale to explain such behaviour. But surely the issue of causality, and the question of whether the observed linkage also exists in other industrial relations settings outside of Germany, certainly, deserve further attention.

## References

- Akgüç, M. and Parasnis, J. (2023). Occupation–education mismatch of immigrant women in Europe. *Social Indicators Research*. Forthcoming.
- Aleksyńska, M. and Tritah, A. (2013). Occupation-education mismatch of immigrant workers in Europe: context and policies. *Economics of Education Review*, 36:229–244.
- Artz, B., Goodall, A. H., and Oswald, A. J. (2018). Do women ask? *Industrial Relations: A Journal of Economy and Society*, 57(4):611–636.
- Battu, H., Belfield, C., and Sloane, P. (1999). Overeducation among graduates: a cohort review. *Education Economics*, 7(1):21–38.
- Belfield, C. (2010). Over-education: what influence does the workplace have? *Economics of Education Review*, 29(2):236–245.
- Berglund, T. and Furåker, B. (2016). Employment protection regulation, trade unions and tenure of employment: an analysis in 23 European countries. *Industrial Relations Journal*, 47(5-6):492–512.
- Blásquez, M. and Budría, S. (2012). Overeducation dynamics and personality. *Education Economics*, 20(3):260–283.
- Bonaccolto-Töpfer, M. and Schnabel, C. (2023). Is there a union wage premium in Germany and which workers benefit most? *Economies*, 11(50):1102005.
- Bracke, P., Pattyn, E., and von dem Knesebeck, O. (2013). Overeducation and depressive symptoms: diminishing mental health returns to education. *Sociology of Health & Illness*, 35(8):1242–1259.
- Bryson, A. (2014). Union wage effects: what are the economic implications of union wage bargaining for workers, firms, and society? *IZA World of Labor*, 35.
- Büchel, F. and Pollmann-Schult, M. (2004). Overeducation and human capital endowments. *International Journal of Manpower*, 25(2):150–166.
- Capsada-Munsech, Q. (2015). The role of social origin and field of study on graduates' overeducation: the case of Italy. *Higher Education*, 69(5):779–807.
- Capsada-Munsech, Q. (2019). Measuring overeducation: incidence, correlation and overlaps across indicators and countries. *Social Indicators Research*, 145(1):279–301.



- Caroleo, F. E. and Pastore, F. (2018). Overeducation at a glance: determinants and wage effects of the educational mismatch based on AlmaLaurea data. *Social Indicators Research*, 137:999–1032.
- Chu Ng, Y. (2003). Earnings and “skill” allocation in the Canadian labor market. *International Journal of Manpower*, 24(8):964–980.
- Davia, M. A., McGuinness, S., and O’Connell, P. J. (2017). Determinants of regional differences in rates of overeducation in Europe. *Social Science Research*, 63:67–80.
- Di Pietro, G. and Cutillo, A. (2006). University quality and labour market outcomes in Italy. *Labour*, 20(1):37–62.
- Diem, A. (2015). Overeducation among graduates from universities of applied sciences: determinants and consequences. *Journal of Economic & Financial Studies*, 3(2):63–77.
- DIW (2022). Sozio-oekonomisches Panel (SOEP)-Version 37, Daten der Jahre 1984–2020, (SOEP-Core, v37, EU Edition). DIW-Deutsches Institut für Wirtschaftsforschung, Berlin. DOI: 10.5684/soep.core.v37eu.
- Duncan, G. and Hoffman, S. (1981). The incidence and wage effects of overeducation. *Economics of Education Review*, 1(1):75–86.
- Ellguth, P. and Kohaut, S. (2022). Tarifbindung und betriebliche Interessenvertretung: Ergebnisse aus dem IAB-Betriebspanel 2021. *WSI-Mitteilungen*, 75(4):328–336.
- Erdsiek, D. (2016). Overqualification of graduates: assessing the role of family background. *Journal for Labour Market Research*, 49(3):253–268.
- Fang, T. and Hartley, J. (2022). Evolution of union wages and determinants. In Zimmermann, K. F., editor, *Handbook of Labor, Human Resources and Population Economics*. Springer-Verlag, Berlin and Heidelberg.
- Fitzenberger, B., Ernst, M., and Haggene, I. (1999). Wer ist noch Mitglied in Gewerkschaften? Eine Panelanalyse für Westdeutschland. *Zeitschrift für Wirtschafts- und Sozialwissenschaften*, 119(2):223–263.
- Flavin, P., Pacek, A. C., and Radcliff, B. (2010). Labor unions and life satisfaction: evidence from new data. *Social Indicators Research*, 98(3):435–449.
- Flavin, P. and Shufeldt, G. (2016). Labor union membership and life satisfaction in the United States. *Labor Studies Journal*, 41(2):171–184.

- Fleming, C. M. and Kler, P. (2008). I'm too clever for this job: a bivariate probit analysis on overeducation and job satisfaction in Australia. *Applied Economics*, 40:1123–1138.
- Freeman, R. B. (1976). *The overeducated American*. Academic Press, New York.
- Freeman, R. B. (1980). The exit-voice tradeoff in the labor market: unionism, job tenure, quits, and separations. *The Quarterly Journal of Economics*, 94(4):643–673.
- Goebel, J., Grabka, M. M., Liebig, S., Kroh, M., Richter, D., Schröder, C., and Schupp, J. (2019). The German Socio-Economic Panel Study (SOEP). *Jahrbücher für Nationalökonomie und Statistik / Journal of Economics and Statistics*, 239(2):345–360.
- Goerke, L. and Pannenberg, M. (2004). Norm-based trade union membership: evidence for Germany. *German Economic Review*, 5(4):481–504.
- Goerke, L. and Pannenberg, M. (2011). Trade union membership and dismissals. *Labour Economics*, 18(6):810–821.
- Green, F., Machin, S., and Wilkinson, D. (1999). Trade unions and training practices in British workplaces. *Industrial and Labor Relations Review*, 52(2):179–195.
- Green, F. and McIntosh, S. (2007). Is there a genuine under-utilization of skills amongst the over-qualified? *Applied Economics*, 39:427–439.
- Groot, W. (1996). The incidence of, and returns to overeducation in the UK. *Applied Economics*, 28:1345–1350.
- Groot, W. and Maassen van den Brink, H. (2000). Overeducation in the labor market: a meta analysis. *Economics of Education Review*, 19:149–158.
- Hirsch, B., Lentge, P., and Schnabel, C. (2022). Uncovered workers in plants covered by collective bargaining: who are they and how do they fare? *British Journal of Industrial Relations*, 60(4):929–945.
- International Labour Office (2012). International standard classification of occupations: structure, group definitions and correspondence tables. [https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms\\_172572.pdf](https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_172572.pdf), downloaded: 2023-01-25.
- Iseke, A. (2014). The part-time job satisfaction puzzle: different types of job discrepancies and the moderating effect of family importance. *British Journal of Industrial Relations*, 52(3):445–469.

- Ivlevs, A. and Veliziotis, M. (2017). What do unions do in times of economic crisis? Evidence from Central and Eastern Europe. *European Journal of Industrial Relations*, 23(1):81–96.
- Jacobs, V., Mahy, B., Rycx, F., and Volral, M. (2021). Over-education among immigrants: the role of demographics, time, and firm characteristics. *Applied Economics*, 53(1):61–78.
- Jäger, S., Noy, S., and Schoefer, B. (2022). The German model of industrial relations: balancing flexibility and collective action. *Journal of Economic Perspectives*, 36(4):53–80.
- Joonas, P. A., Gupta, N. D., and Wadensjö, E. (2014). Overeducation among immigrants in Sweden: incidence, wage effects and state dependence. *IZA Journal of Migration*, 3(9):1–23.
- Keane, L., Pacek, A., and Radcliff, B. (2012). Organized labor, democracy, and life satisfaction: a cross-national analysis. *Labor Studies Journal*, 37(3):253–270.
- Kiker, B., Santos, M. C., and De Oliveira, M. M. (1997). Overeducation and undereducation: evidence for Portugal. *Economics of Education Review*, 16(2):111–125.
- Korpi, T. and Tählin, M. (2009). Educational mismatch, wages, and wage growth: overeducation in Sweden, 1974–2000. *Labour Economics*, 16(2):183–193.
- Lammers, A., Lukowski, F., and Weis, K. (2022). The relationship between works councils and firms’ further training provision in times of technological change. *British Journal of Industrial Relations*, 12710.
- Mavromaras, K., McGuinness, S., and Fok, Y. K. (2009). Assessing the incidence and wage effects of overskilling in the Australian labour market. *Economic Record*, 85(268):60–72.
- Mavromaras, K., Sloane, P., and Wei, Z. (2012). The role of education pathways in the relationship between job mismatch, wages and job satisfaction: a panel estimation approach. *Education Economics*, 20(3):303–321.
- McGoldrick, K. and Robst, J. (1996). Gender differences in overeducation: a test of the theory of differential overqualification. *The American Economic Review*, 86(2):280–284.
- OECD (2022a). Employment: labour force participation rate, by sex and age group. <https://stats.oecd.org/index.aspx?queryid=103872#>, downloaded: 2022-12-28.

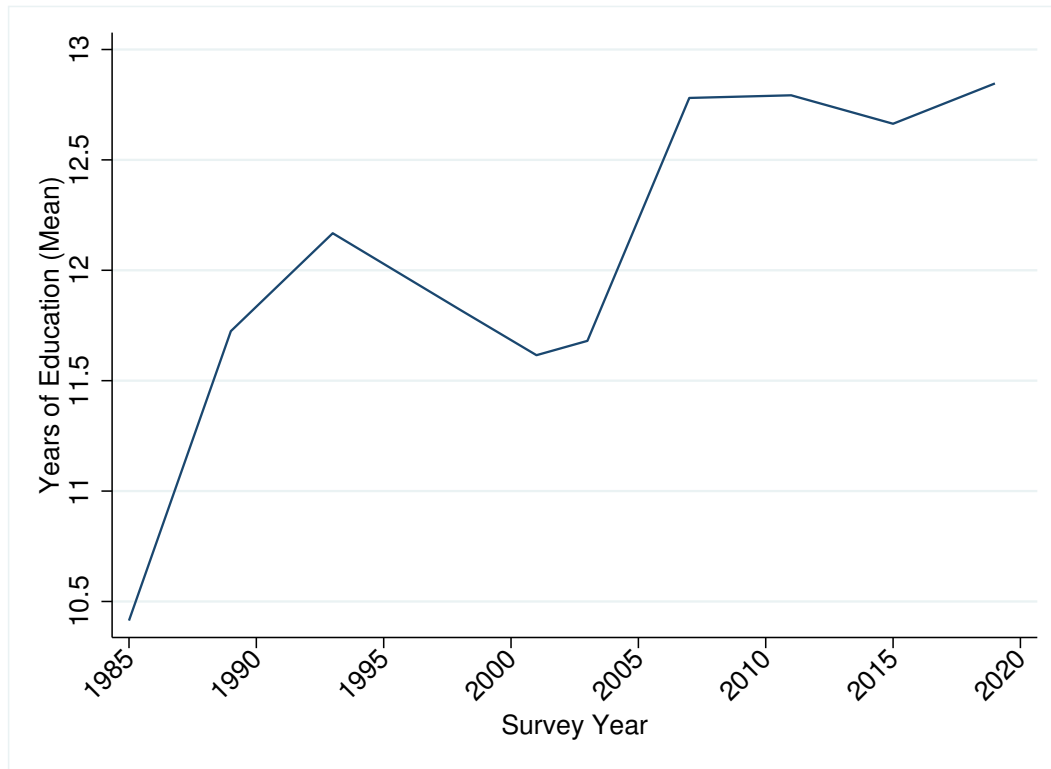
- OECD (2022b). Employment: share of employed in part-time employment, by sex and age group. <https://stats.oecd.org/index.aspx?queryid=54746>, downloaded: 2022-12-28.
- OECD and AIAS (2021). *Institutional characteristics of trade unions, wage setting, state intervention and social pacts*. OECD Publishing, Paris.
- Ordine, P. and Rose, G. (2009). Overeducation and instructional quality: a theoretical model and some facts. *Journal of Human Capital*, 3(1):73–105.
- Pierse, T. and McHale, J. (2015). Unions and involuntary job separations. *Human Resource Management Journal*, 25(4):496–515.
- Radcliff, B. (2005). Class organization and subjective well-being: a cross-national analysis. *Social Forces*, 84(1):513–530.
- Robst, J. (1995). College quality and overeducation. *Economics of Education Review*, 14(3):221–228.
- Rumberger, R. W. (1981). The rising incidence of overeducation in the US labor market. *Economics of Education Review*, 1(3):293–314.
- Santiago-Vela, A. and Mergener, A. (2022). Gender overeducation gap in the digital age: can spatial flexibility through working from home close the gap? *Social Science Research*, 106:102727.
- Schmidt, C. M. and Zimmermann, K. F. (1991). Work characteristics, firm size and wages. *The Review of Economics and Statistics*, 73(4):705–710.
- Sharma, S. and Sharma, P. (2017). Educational mismatch and its impact on earnings: evidence from Indian labour market. *International Journal of Social Economics*, 44(12):1778–1795.
- Sicherman, N. (1991). "Overeducation" in the labor market. *Journal of Labor Economics*, 9(2):101–122.
- Sloane, P., Battu, H., and Seaman, P. (1999). Overeducation, undereducation and the British labour market. *Applied Economics*, 31:1437–1453.
- Sloane, P. J., Battu, H., and Seaman, P. T. (1996). Overeducation and the formal education/experience and training trade-off. *Applied Economics Letters*, 3(8):511–515.
- Statistisches Bundesamt (2021a). Beschäftigte des öffentlichen Dienstes in Millionen. [https://www.destatis.de/DE/Themen/Staat/Oeffentlicher-Dienst/\\_Grafik/\\_Interaktiv/personal-beschaeftigte.html](https://www.destatis.de/DE/Themen/Staat/Oeffentlicher-Dienst/_Grafik/_Interaktiv/personal-beschaeftigte.html), downloaded: 2023-1-4.

- Statistisches Bundesamt (2021b). Prüfungen an Hochschulen 2020. [https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Publikationen/Downloads-Hochschulen/pruefungen-hochschulen-2110420207005.xlsx?\\_\\_blob=publicationFile](https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Publikationen/Downloads-Hochschulen/pruefungen-hochschulen-2110420207005.xlsx?__blob=publicationFile), downloaded: 2023-1-25.
- Statistisches Bundesamt (2022). Erwerbstätigkeit: Erwerbstätigenquoten 1991 bis 2021. <https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Erwerbstaetigkeit/Tabellen/erwerbstaetigenquoten-gebietsstand-geschlecht-altergruppe-mikrozensus.html>, downloaded: 2022-12-29.
- Tarvid, A. (2015). The role of industry in the prevalence of overeducation in Europe. *Procedia Economics and Finance*, 30:876–884.
- Thurow, L. C. (1975). *Generating inequality: mechanisms of distribution in the U.S. economy*. Basic books, New York.
- Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica: Journal of the Econometric Society*, 26(1):24–36.
- Tsang, M. C. and Levin, H. M. (1985). The economics of overeducation. *Economics of Education Review*, 4(2):93–104.
- Turmo-Garuz, J. and Bartual-Figueras, M.-T. (2019). Factors associated with overeducation among recent graduates during labour market integration: the case of Catalonia (Spain). *Social Indicators Research*, 144:1273–1301.
- UNESCO (2006). International Standard Classification of Education (ISCED 1997). [http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-1997-en\\_0.pdf](http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-1997-en_0.pdf), downloaded: 2023-01-25.
- Verdugo, R. R. and Verdugo, N. T. (1989). The impact of surplus schooling on earnings: some additional findings. *Journal of Human Resources*, 24(4):629–643.
- Verhaest, D. and Omey, E. (2006). The impact of overeducation and its measurement. *Social Indicators Research*, 77(3):419–448.
- Verhaest, D. and Omey, E. (2010). The determinants of overeducation: different measures, different outcomes? *International Journal of Manpower*, 31(6):608–625.
- Verhaest, D. and Omey, E. (2012). Overeducation, undereducation and earnings: further evidence on the importance of ability and measurement error bias. *Journal of Labor Research*, 33(1):76–90.

- Verhaest, D. and Verhofstadt, E. (2016). Overeducation and job satisfaction: the role of job demands and control. *International Journal of Manpower*, 37(3):456–473.
- Voon, D. and Miller, P. W. (2005). Undereducation and overeducation in the Australian labour market. *Economic Record*, 81:S22–S33.
- Wald, S. and Fang, T. (2008). Overeducated immigrants in the Canadian labour market: evidence from the workplace and employee survey. *Canadian Public Policy/ Analyse de Politiques*, 34(4):457–479.

## A Development of education

Figure 1: Development of weighted mean years of education per survey year (Own depiction on basis of(DIW, 2022))



## B Extended tables

Table 9: Extended summary statistics by trade union membership

	All						TUM=0						TUM=1						t-test
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max			
Gender	0.458	0.498	0	1	0.492	0.500	0	1	0.492	0.500	0	1	0.325	0.469	0	1	-0.167***		
Direct migrant	0.130	0.337	0	1	0.136	0.342	0	1	0.136	0.342	0	1	0.110	0.313	0	1	-0.0251***		
Indirect migrant	0.040	0.195	0	1	0.041	0.199	0	1	0.041	0.199	0	1	0.034	0.182	0	1	-0.00689***		
No migrant	0.830	0.376	0	1	0.823	0.381	0	1	0.823	0.381	0	1	0.855	0.352	0	1	0.0319***		
Age	42.221	11.215	17	65	41.675	11.277	17	65	41.675	11.277	17	65	44.310	10.723	18	65	2.634***		
Age <sup>2</sup> /100	19.084	9.492	2.9	42.3	18.640	9.500	2.9	42.3	18.640	9.500	2.9	42.3	20.783	9.265	3.2	42.3	2.143***		
Single	0.288	0.453	0	1	0.302	0.459	0	1	0.302	0.459	0	1	0.237	0.425	0	1	-0.0646***		
Married	0.581	0.494	0	1	0.568	0.495	0	1	0.568	0.495	0	1	0.630	0.483	0	1	0.0629***		
Separate	0.131	0.338	0	1	0.131	0.338	0	1	0.131	0.338	0	1	0.133	0.339	0	1	0.002		
Number of Kids	1.312	1.139	0	12	1.308	1.146	0	12	1.308	1.146	0	12	1.327	1.113	0	11	0.019		
White collar	0.614	0.487	0	1	0.657	0.475	0	1	0.657	0.475	0	1	0.447	0.497	0	1	-0.210***		
Civil Servant	0.058	0.234	0	1	0.045	0.208	0	1	0.045	0.208	0	1	0.108	0.310	0	1	0.0628***		
Public	0.262	0.440	0	1	0.241	0.428	0	1	0.241	0.428	0	1	0.342	0.474	0	1	0.100***		
Prior Unempl.	0.325	0.468	0	1	0.352	0.477	0	1	0.352	0.477	0	1	0.221	0.415	0	1	-0.131***		
Permanent	0.911	0.285	0	1	0.902	0.297	0	1	0.902	0.297	0	1	0.946	0.226	0	1	0.0442***		
Full-time	0.759	0.428	0	1	0.731	0.443	0	1	0.731	0.443	0	1	0.866	0.341	0	1	0.135***		
Tenure	10.791	10.177	0	50.9	9.618	9.549	0	50.9	9.618	9.549	0	50.9	15.286	11.205	0	49.3	5.668***		
Tenure <sup>2</sup> /100	2.200	3.512	0	25.9	1.837	3.186	0	25.9	1.837	3.186	0	25.9	3.592	4.273	0	24.3	1.755***		
Firm size: < 20	0.214	0.410	0	1	0.252	0.434	0	1	0.252	0.434	0	1	0.070	0.256	0	1	-0.182***		
Firm size: 20-200	0.286	0.452	0	1	0.301	0.459	0	1	0.301	0.459	0	1	0.228	0.420	0	1	-0.0728***		
Firm size: 200-2000	0.237	0.425	0	1	0.226	0.418	0	1	0.226	0.418	0	1	0.276	0.447	0	1	0.0504***		
Firm size: >2000	0.263	0.441	0	1	0.221	0.415	0	1	0.221	0.415	0	1	0.425	0.494	0	1	0.204***		



Table 10: Extended summary statistics and t-test by trade union membership (cont.)

	All			TUM=0			TUM=1			t-test				
	mean	sd	max	min	max	mean	sd	min	max					
Ind: Agriculture	0.010	0.101	0	0	1	0.012	0.108	0	1	0.005	0.072	0	1	-0.00661***
Ind: Energy	0.011	0.102	0	0	1	0.009	0.094	0	1	0.017	0.128	0	1	0.00769***
Ind: Manufacturing	0.272	0.445	0	0	1	0.243	0.429	0	1	0.384	0.486	0	1	0.141***
Ind: Mining	0.003	0.059	0	0	1	0.002	0.042	0	1	0.010	0.099	0	1	0.00802***
Ind: Construction	0.061	0.240	0	0	1	0.066	0.248	0	1	0.045	0.207	0	1	-0.0209***
Ind: Trade	0.146	0.353	0	0	1	0.163	0.369	0	1	0.079	0.270	0	1	-0.0836***
Ind: Transport	0.056	0.229	0	0	1	0.044	0.204	0	1	0.101	0.302	0	1	0.0577***
Ind: Bank	0.042	0.201	0	0	1	0.047	0.212	0	1	0.022	0.148	0	1	-0.0249***
Ind: Service	0.373	0.484	0	0	1	0.390	0.488	0	1	0.309	0.462	0	1	-0.0808***
Ind: Other	0.026	0.160	0	0	1	0.026	0.158	0	1	0.028	0.165	0	1	0.002
ISCO: Legislators, ...	0.044	0.205	0	0	1	0.047	0.212	0	1	0.032	0.175	0	1	-0.0157***
ISCO: Professionals, ...	0.135	0.342	0	0	1	0.140	0.347	0	1	0.114	0.318	0	1	-0.0259***
ISCO: Technicians, ...	0.248	0.432	0	0	1	0.255	0.436	0	1	0.220	0.414	0	1	-0.0347***
ISCO: Clerks	0.137	0.344	0	0	1	0.141	0.348	0	1	0.123	0.328	0	1	-0.0183***
ISCO: Service	0.119	0.324	0	0	1	0.129	0.335	0	1	0.083	0.276	0	1	-0.0455***
ISCO: Agriculture, ...	0.008	0.089	0	0	1	0.008	0.091	0	1	0.006	0.079	0	1	-0.00210*
ISCO: Craft, ...	0.147	0.354	0	0	1	0.129	0.335	0	1	0.214	0.410	0	1	0.0844***
ISCO: Plant operators, ...	0.087	0.282	0	0	1	0.072	0.258	0	1	0.146	0.353	0	1	0.0744***
ISCO: Elementary	0.075	0.264	0	0	1	0.079	0.269	0	1	0.062	0.242	0	1	-0.0165***
N	62,134					50,035				12,099				

Years of undereducation measured in absolute terms. SOEP weights applied. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 11: Summary statistics by trade union membership and institutions

	Institution=0		Institution =1		Institution =0		Institution =1		Institution =0		Institution =1					
					TUM=0		TUM=1		TUM=0		TUM=1					
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd				
<b>Works council</b>																
Years UE	0.093	0.386	0.101	0.389	0.008	0.008	0.094	0.388	0.075	0.346	-0.019	0.105	0.404	0.090	0.347	-0.0152*
Years OE	0.156	0.606	0.163	0.586	0.008	0.008	0.158	0.611	0.123	0.539	-0.035	0.176	0.602	0.131	0.543	-0.0452***
UE	0.088	0.284	0.100	0.300	0.0117**	0.090	0.286	0.286	0.061	0.240	-0.0287*	0.103	0.303	0.094	0.292	-0.009
OE	0.140	0.347	0.154	0.361	0.0136**	0.142	0.349	0.349	0.113	0.316	-0.0291*	0.169	0.374	0.115	0.320	-0.0531***
Matched	0.772	0.420	0.746	0.435	-0.0253***	0.768	0.422	0.422	0.826	0.380	0.0578***	0.729	0.445	0.790	0.407	0.0616***
N	10,439		14,796			9,836		603		10,833		3,963				
<b>Collective bargaining</b>																
Years UE	0.095	0.369	0.090	0.387	-0.006	0.093	0.366	0.123	0.415	0.029	0.099	0.419	0.064	0.279	0.502	-0.0349**
Years OE	0.222	0.701	0.154	0.571	-0.0677***	0.220	0.694	0.247	0.792	0.027	0.164	0.595	0.127	0.502	0.335	-0.0366*
UE	0.098	0.298	0.095	0.294	-0.003	0.097	0.296	0.117	0.322	0.020	0.101	0.301	0.081	0.272	0.407	-0.0204*
OE	0.210	0.407	0.147	0.355	-0.0626***	0.211	0.408	0.200	0.400	-0.011	0.155	0.361	0.128	0.335	0.407	-0.0262**
Matched	0.692	0.462	0.757	0.429	0.0654***	0.692	0.462	0.683	0.466	-0.009	0.745	0.436	0.791	0.407	0.407	0.0466***
N	7,355		6,684			6,927		428		5,094		1,590				

Years of undereducation measured in absolute terms. SOEP weights applied. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 12: Panel RE tobit regressions

Years of...	(2) Undereducation	(4) Overeducation
Trade Union	-0.0172 (0.0263)	-0.148*** (0.0334)
Gender	0.0489 (0.0311)	-0.241*** (0.0387)
Direct migrant	1.405*** (0.0360)	-0.971*** (0.0543)
Indirect migrant	0.638*** (0.0584)	-0.350*** (0.0759)
Age	-0.0335*** (0.00703)	0.0427*** (0.00809)
Age <sup>2</sup> /100	0.0493*** (0.00791)	-0.0574*** (0.00930)
Married/ Partner	-0.00196 (0.0346)	-0.106*** (0.0357)
Separate/ Widowed	0.0981** (0.0439)	-0.295*** (0.0502)
Number of Kids	0.0832*** (0.0119)	-0.0670*** (0.0153)
White Collar	-0.438*** (0.0295)	0.580*** (0.0375)
Civil Servant	-1.150*** (0.0635)	0.824*** (0.0818)
Prior Unempl.	0.0288 (0.0281)	0.0509 (0.0323)
Permanent	-0.0365 (0.0311)	0.0316 (0.0351)
Full-time	-0.00620 (0.0265)	-0.0252 (0.0298)
PublicSector	0.101*** (0.0289)	-0.104*** (0.0332)
Tenure	-0.00310 (0.00300)	-0.0230*** (0.00366)
Tenure <sup>2</sup> /100	0.0421*** (0.00801)	0.00899 (0.0111)
Firm Size:20-200	-0.0291 (0.0273)	0.118*** (0.0315)
Firm Size:200-2000	-0.0564* (0.0300)	0.130*** (0.0354)
Firm Size: > 2000	-0.125*** (0.0310)	0.246*** (0.0366)
<i>N</i>	62,445	62,445

Years of undereducation measured in absolute terms. Columns (2) and (4) year, month, industry and occupation fixed effects. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## C Robustness checks

### C.1 Robustness to educational mismatch definition

Two alternative measures of educational mismatch are used. The indirect self-assessment (ISA) is based on a direct survey question asking what kind of training the respondents think would be required for their current job. In the SOEP this question can be answered with *"0 - No training"*, *"1 - Vocational training"*, *"2 - Vocational college degree"* or *"4 - University degree"*. To create a categorical variable of educational mismatch, these answers can be compared to level of attained education measured on a similar scale. To create a continuous measure, we transformed the answers by using the number of years typically spent in education to attain such level. This year-based measure can then be compared to the years actually needed (Verhaest and Omey, 2006).

The job analyst measure (JA) makes use of the assessment of skills for each occupational group by trained analysts captured in official classifications of occupations, such as the Dictionary of Occupational Titles (DOT) (Rumberger, 1981). Following e.g. Capsada-Munsech (2019), we employ the skill classification presented in the International Standard Classification of Occupations (ISCO) (International Labour Office, 2012) and the skill levels assigned to educational degrees by the International Standard Classification of Education (ISCED) (UNESCO, 2006). The ISCO (version 88, 1-digit level) distinguishes 9 occupational groups which are attributed to three different skill levels ranging between *"1 - lowest required skills"* to *"4 - highest required skill level"*. The ISCED (version 97) differentiates between 6 educational levels, which are attributed to the four skill levels allowing for a comparison of attained and required educational levels. Table 13 shows the summary statistics for these alternative measures, while Table 14 displays the regression results.

Table 13: Summary statistics for alternative definitions of educational mismatch by trade union membership

	All		TUM = 0		TUM = 1		t-test
	mean	sd	mean	sd	mean	sd	
ISA: Years UE	0.6731	0.953	0.6612	0.9527	0.7186	0.9531	0.0575***
ISA: Years OE	0.7329	1.2842	0.7739	1.3287	0.5761	1.0829	-0.198***
ISA: UE	0.0659	0.2481	0.0679	0.2515	0.0582	0.2342	-0.00963***
ISA: OE	0.2647	0.4412	0.2629	0.4402	0.2714	0.4447	0.00855
ISA: Matched	0.6674	0.4711	0.6668	0.4714	0.67	0.4702	0.00323
JA: Years UE	1.0945	1.5309	1.0983	1.5401	1.08	1.4952	-0.0183
JA: Years OE	1.0045	1.7488	1.0614	1.7895	0.7864	1.5642	-0.275***
JA: UE	0.1814	0.3854	0.1845	0.3879	0.1696	0.3753	-0.0150***
JA: OE	0.1595	0.3662	0.1644	0.3706	0.1409	0.348	-0.0234***
JA: Matched	0.659	0.474	0.6511	0.4766	0.6895	0.4627	0.0384***
N	62,134		50,035		12,099		

Years of undereducation measured in absolute terms. SOEP weights applied. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 14: Panel RE tobit regressions with alternative educational mismatch definition

Years of ...	(1)	(2)	(3)	(4)
	Indirect self-assessment		Job analyst	
	Undereducation	Overeducation	Undereducation	Overeducation
Full sample				
Trade Union	0.0228 (0.0195)	-0.0741** (0.0294)	0.0205* (0.0105)	-0.0752*** (0.0144)
N	62,445	62,445	57,537	62,445
Male subsample				
Trade Union	0.0571** (0.0250)	-0.101*** (0.0390)	0.0346** (0.0139)	-0.0992*** (0.0196)
N	31,802	31,802	29,606	31,802
Female subsample				
Trade Union	-0.0199 (0.0313)	-0.0444 (0.0444)	0.00287 (0.0159)	-0.0383* (0.0214)
N	30,643	30,643	27,931	30,643

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. In column (3), individuals working in elementary occupations are not considered, as they cannot be undereducated by definition. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## C.2 Robustness to estimation methodology

Table 15: Pooled bivariate probit and multinomial logit estimations: Average marginal effects

	Biprobit		Mlogit		
	Undereduc.	Overeduc.	Undereduc.	Overeduc.	Matched
Full sample					
Trade Union	-0.0361 (0.023)	-0.0665*** (0.025)	-0.00501 (0.004)	-0.0145*** (0.005)	0.0195*** (0.006)
N	62,445	62,445	62,445	62,445	62,445
Male subsample					
Trade Union	-0.000996 (0.031)	-0.0775** (0.032)	0.0028 (0.006)	-0.0179*** (0.008)	0.0151* (0.007)
N	31,802	31,802	31,802	31,802	31,802
Female subsample					
Trade Union	-0.0692* (0.031)	-0.0284 (0.040)	-0.0117* (0.006)	-0.00608 (0.008)	0.0177* (0.010)
N	30,643	30,643	30,643	30,643	30,643

Column (1) controls for the correlation between overeducation and undereducation, while column (3) additionally accounts for the correlation with being matched, which is set to be the reference group. Columns (1) and (2) include the full set of covariates. Standard errors clustered at individual level and presented in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## D Heterogeneity analysis

Table 16: Panel RE tobit regressions by sector

Years of...	(1)	(2)	(3)	(4)
	Undereducation		Overeducation	
	Private	Public	Private	Public
Male subsample				
Trade Union	-0.0215 (0.0398)	0.0414 (0.0738)	-0.276*** (0.0565)	-0.0485 (0.0890)
<i>N</i>	25,092	6,514	25,092	6,514
Female subsample				
Trade Union	0.0227 (0.0511)	-0.113* (0.0677)	-0.0647 (0.0639)	0.0197 (0.0639)
<i>N</i>	20,815	9,806	20,815	9,806

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. In all models individuals working in the mining industry are not considered, as off the high correlation with working in the public sector. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 17: Panel RE tobit regressions by contract type

Years of...	(1)	(2)	(3)	(4)
	Undereducation		Overeducation	
	Part-time	Full-time	Part-time	Full-time
Male subsample				
Trade Union	-0.250 (0.224)	0.00542 (0.0349)	0.0981 (0.237)	-0.225*** (0.0481)
<i>N</i>	1,868	29,934	1,868	29,934
Female subsample				
Trade Union	0.0136 (0.0638)	-0.0459 (0.0508)	0.00562 (0.0737)	-0.0400 (0.0576)
<i>N</i>	15,148	15,495	15,148	15,495

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 18: Panel RE tobit regressions by age cohort

	(1)	(2)	(3)	(4)
Years of...	Undereducation		Overeducation	
	$\leq 42$	$> 42$	$\leq 42$	$> 42$
Male subsample				
Trade Union	-0.135**	0.0640	-0.171***	-0.258***
	(0.0557)	(0.0463)	(0.0602)	(0.0702)
<i>N</i>	15,358	16,444	15,358	16,444
Female subsample				
Trade Union	-0.0555	-0.000494	-0.312***	0.0183
	(0.0784)	(0.0482)	(0.0880)	(0.0557)
<i>N</i>	14,688	15,955	14,688	14,982

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 19: Panel RE tobit regressions by region

	(1)	(2)	(3)	(4)
Years of...	Undereducation		Overeducation	
	West	East	West	East
Male subsample				
Trade Union	0.00290	-0.148	-0.264***	-0.163**
	(0.0359)	(0.141)	(0.0559)	(0.0799)
<i>N</i>	25,453	6,097	25,453	6,349
Female subsample				
Trade Union	0.00304	-0.147	-0.0272	-0.150*
	(0.0427)	(0.129)	(0.0571)	(0.0869)
<i>N</i>	23,971	6,672	23,971	6,458

Years of undereducation measured in absolute terms. Columns (1) to (4) include the full set of covariates. In column (2) in the male subsample, we cannot control for individuals being a civil servant. In column (4) for the female subsample we cannot control for individuals being a civil servant and being interviewed in 1989. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$