

Geißler, Theresa; Goerke, Laszlo

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ORIGINAL ARTICLE OPEN ACCESS

Educational Mismatch and Trade Union Membership

Theresa Geißler¹ | Laszlo Goerke^{1,2,3,4} ¹Trier University - IAAEU, Trier, Germany | ²IZA, Bonn, Germany | ³CESifo, München, Germany | ⁴GLO, Essen, Germany**Correspondence:** Laszlo Goerke (goerke@iaaeu.de)**Received:** 11 November 2024 | **Revised:** 6 February 2025 | **Accepted:** 12 March 2025**Keywords:** educational mismatch | German Socio-Economic Panel | trade union membership

ABSTRACT

We hypothesize that trade unions assist their members in avoiding situations of educational mismatch. We test this hypothesis using data from the German Socio-Economic Panel and find that trade union membership is negatively associated with overeducation and positively associated with the likelihood of being educationally matched. These correlations are especially pronounced among core groups of members. Our findings suggest that a strong trade union presence within these groups helps avert the adverse consequences of overeducation and educational mismatch. We observe no systematic linkage between union membership and undereducation.

JEL Classification: I21, J24, J51

1 | Introduction

Educational mismatch occurs when job requirements and an employee's qualifications diverge. These situations of mismatch are a widespread phenomenon and 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 frequently. Similarly, the groups that are particularly affected as well as characteristics associated with a divergence between the required and available qualifications have been studied intensively.¹ In contrast, the effects of labor market institutions, in general, and of trade unions, in particular, have scarcely been looked at.

This is surprising because trade unions can affect the attractiveness of hiring individuals with either excessive or insufficient educational qualifications. Union membership can also influence the employee's decisions to enter or remain in situations characterized by educational mismatch. Such an

impact of trade unions may arise because members possess superior information regarding job features, required qualifications, compensation, career prospects, and the costs and benefits associated with changing jobs. In negotiations, trade unions are involved in establishing formal requirements for jobs with employers to define pay scales, they bargain about promotion rules and influence the conditions allowing firms to dismiss employees or prevent such dismissals. Therefore, trade unions can enhance the knowledge of members about the consequences of overeducation, opportunities for leaving such a state of educational mismatch and the likely outcomes of a resulting job change. Trade unions can also improve a member's bargaining power in negotiations with the employer when attempting to avoid overeducation. Such a bargaining power effect can arise because union membership strengthens protection against a job loss or dismissal. Moreover, if fellow members support a request for a better educational match, a firm's costs of declining it can increase. In sum, trade unions may help members to avoid overeducation and reduce its extent by providing information and strengthening the ability to

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leave a situation of educational mismatch. Comparable information and bargaining power effects may also alter a union member's likelihood and extent of undereducation.

Based on these considerations, we empirically analyze the relationship between union membership and various indicators of educational mismatch for Germany. The country represents an interesting research objective because labor relations are highly formalized. Many jobs require the completion of a specific apprenticeship scheme or a university degree in a particular subject or field. Consequently, employees are well aware of the possibility of educational mismatch. Moreover, educational mismatch and especially overeducation have increased during the last decades. Therefore, the scope for a union membership effect has gone up. Additionally, collective bargaining coverage does not imply union membership for covered employees, or vice versa. Accordingly, the German industrial relations system enables individual trade union membership to play a role. Finally, the German trade union federation (Deutscher Gewerkschaftsbund, DGB) has identified educational mismatch as a topic of concern and repeatedly highlighted its societal and individual impact. It has also commissioned a scientific study on the extent and determinants of overeducation (Deutscher Gewerkschaftsbund 2014).

Using data from the German Socio-Economic Panel (SOEP) for a period of over 30 years, we show that trade union membership is negatively related to the duration of overeducation as well as its likelihood. Moreover, membership is positively linked to the likelihood of being educationally matched, meaning that individuals are neither over- nor undereducated. We observe no systematic correlation with undereducation. Looking at subgroups, the effects can be observed particularly for those individuals who exhibit a comparatively high likelihood of union membership. This suggests that trade unions specifically assist their core members when it comes to addressing educational mismatch, supporting the notion of a bargaining effect. Because informational advantages associated with membership are unlikely to vary across subgroups in accordance with the share of employees belonging to a trade union, our results bring forth no evidence for an informational channel.

The paper provides background information on the institutional set-up in Germany, focusing particularly on industrial relations and educational mismatch in Section 2. In Section 3, we derive hypotheses about the correlation between an employee's trade union membership and various indicators of educational mismatch. We review related analyses in Section 4, while we describe the data and explain the empirical approach in Section 5. We present our central findings, several robustness checks, and a heterogeneity analysis in Section 6 and finish with some concluding remarks in Section 7.

2 | Institutional Set-Up

2.1 | Industrial Relations in Germany

As of now, approximately 16% of employees in Germany are members of a trade union. This fraction has declined substantially, from a peak of about 36% just after the reunification in

1990 (OECD and AIAS 2023). Union members in Germany generally pay a (tax-deductible) membership fee of 1% of their gross wage. 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 aspects.

In contrast to other countries (see, e.g., Bryson 2014; Fang and Hartley 2022), there is no robust evidence of wage differences between union members and non-members in Germany (Fitzenberger et al. 1999; Goerke and Pannenberg 2004; Schmidt and Zimmermann 1991).² A major reason is that union membership is not directly linked to collective bargaining. This can already be observed when comparing the bargaining coverage of close to 40% in the private sector in 2023, respectively almost 90% in the public sector (Hohendanner and Kohaut 2024), to union density. From a legal perspective, collective bargaining agreements apply to all firms covered by the contract and to union members who work in a covered firm. However, in the vast majority of cases, firms pay all employees the negotiated wage, irrespective of their union membership status. Collective bargaining agreements usually contain provisions concerning remuneration, and often with regard to working time, vacation entitlements, and overtime pay. Moreover, they define pay scales and qualification and tenure requirements that have to be fulfilled to move from one to the next level. Collective bargaining agreements may also include job security and training provisions. While pay is often negotiated annually, bargaining about other components usually takes place less frequently. Firms not subject to collective agreements can negotiate wages and working conditions individually with their staff. However, in about 50% of the relevant contracts, at least pay is aligned to a collective agreement (Hohendanner and Kohaut 2024).

In addition to collective bargaining, co-determination is still an important element of the German industrial relations system (Jäger et al. 2022). Co-determination at the plant level in the private sector takes place via works councils. They can be established by a vote among employees in firms with at least five employees. Subsequent to being set up, such votes are repeated at regular intervals. Since these votes are not compulsory, works councils currently exist in less than 10% of all eligible private-sector establishments. Given their prevalence in larger firms, about 40% of private-sector employees are subject to co-determination. This percentage has declined substantially from about 55% in the mid 1990. In the public sector, an analogue to works councils exists. Such personnel councils are much more widespread (Hohendanner and Kohaut 2024).

2.2 | Trade Unions and Educational Mismatch in Germany

The incidence of educational mismatch has risen substantially over the last decades. According to the OECD, the share of individuals possessing more qualifications than required for their job was on average 15.3% in the European Union in 2022. Moreover, 16.8% were underqualified, implying that around every third individual's work exhibited educational mismatch. In Germany, the respective shares were slightly larger, with 18.8% being overqualified and 21% being underqualified

(OECD 2022). While the OECD provides no data on the development of educational mismatch for the entire German labor force over time, there is such information for graduates aged 25–34 between 2011 and 2022. These statistics show an increase of overqualification from 11.7% in 2011 to 18.8% in 2022 (European Centre for the Development of Vocational Training 2025). Considering all employed individuals, data from the SOEP for the period 1984–2020 reveals a similar pattern (see Clogg and Shockey 1984; Verdugo and Verdugo 1989, and Figure A1 in Appendix A).

Due to the rising prevalence of educational mismatch and its potential negative consequences, trade unions in Germany try to establish conditions that counteract the development of educational mismatch and other forms of underemployment. The DGB, for example, requests a better compatibility of family and work in order to reduce gender frictions in the risk of underemployment (Deutscher Gewerkschaftsbund 2014). Moreover, trade unions advocate employment agencies to rely on qualification-oriented counseling to reduce the risk of educational mismatch among unemployed individuals who re-enter the labor market (Deutscher Gewerkschaftsbund 2014). Another example of the German trade unions' stance on underemployment and educational mismatch is the statement on the draft law regulating the employment of civil servants who worked for the post office prior to its privatization. This draft permitted a broader deployment of civil servants, also to jobs for which they were overqualified. The trade union representing these employees strongly objected to the possibility of assigning such jobs (Vereinte Dienstleistungsgewerkschaft 2014). Trade unions also engage in strengthening the role of on-the-job training, as this is not only relevant for individuals lacking any kind of apprenticeship or qualification but particularly for individuals who are overeducated (IG Metall 2018). This is also visible in the DGB's engagement in enhancing and extending the Continuing Education Act (Deutscher Gewerkschaftsbund 2023).

In sum, trade unions in Germany have identified the increasing extent of educational mismatch as a development having potentially adverse consequences for their members. In consequence, they promote policies and regulations that help to avoid its expansion.

3 | Union Membership and Educational Mismatch

Overeducation has been associated with a number of detrimental outcomes, such as lower job satisfaction (e.g., Battu et al. 1999; Iseke 2014; Verhaest and Verhofstadt 2016), wage losses (e.g., Cohn and Khan 1995; Duncan and Hoffman 1981; Heijke et al. 2003; Korpi and Tåhlin 2009; Sattinger and Hartog 2013; Sicherman 1991), and possibly 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.

Overeducation is arguably more likely to occur or persist when employees are unaware of how to secure a more suitable job, lack information about alternative employment opportunities, or do not fully comprehend the negative consequences associated with overeducation. Trade unions in Germany provide members with

job-related information, such as required levels of qualifications or associated wages and benefits. To illustrate the informational role of membership, first, a look at the websites of German trade unions is instructive. The major German unions emphasize the informational benefits when listing the main arguments for becoming a member.³ Second, the research institute of the DGB runs a continuous online survey to allow for pay comparisons at a very detailed level, inter alia, based on an individual's formal qualifications and experience.⁴ As a third example, the IG Metall, the largest German trade union with more than 2 million members, provides comprehensive information on collective bargaining agreements it has negotiated to its members.⁵ In addition to these direct informational benefits, union members take a more active stance in social exchanges, and union membership can provide 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.⁶ Therefore, we hypothesize 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 must realize their aspirations. If trade unions act as the voice of 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, e.g., Berglund and Furåker 2016; Freeman 1980; Goerke and Pannenberg 2011; Ivlevs and Veliziotis 2017; Pierse and McHale 2015), they will more often express an ambition to obtain a better job match.⁷ As mentioned above, trade unions represent their members in job-related legal disputes. In 2023, about 65,000 cases were handled by lawyers of the member unions of the DGB in labor courts. About one-third of them were related to pay issues (DGB Rechtsschutz 2024). Since union representation in labor courts is free for members, whereas non-members have to pay their lawyers and possible court fees themselves, union members face lower expected costs of overcoming situations of overeducation and inadequate pay. These lower costs are one reason why union members possess greater individual bargaining power. A further source for a better individual negotiation position is the support for union members either at the plant level or in local offices, which especially the large German trade unions emphasize on their websites.

In sum, overcoming a situation of overeducation requires employees to actively initiate the necessary changes. Union members may be more willing to undertake such steps because they know more about their potentially beneficial consequences and possess a greater bargaining power when determining the conditions of a new job.

Our considerations can be summarized as follows:

Hypothesis 1.1. *Trade union members exhibit lower levels of overeducation than comparable non-members.*

Hypothesis 1.2. *Trade union members are less likely to be overeducated than comparable non-members.*

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 Omeij 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—better information and greater bargaining power—could assist them in acquiring a position for which they are inadequately educated.

Based on the above, we postulate:

Hypothesis 2.1. *Trade union members exhibit higher levels of undereducation than comparable non-members.*

Hypothesis 2.2. *Trade union members are more likely to be undereducated than comparable non-members.*

We expect the correlation between union membership and undereducation to be weaker than the relationship to overeducation. This is the case for a number of reasons: First, trade unions are strong advocates of the German apprenticeship system. An important element of this support has been demands that all successful graduates of such vocational training should be offered a matching job in the company where the training took place (c.f. IG Metall 2012). Therefore, the scope for undereducation is limited at this stage. Second, by actively promoting undereducation, trade unions would undermine the system of pay scales which makes wage determination less arbitrary. Consequently, support is likely to be more tacit than in the case of overeducation. Finally, trade unions advocate fair and adequate wages. The argument that an individual's remuneration does not correspond to these requirements is obviously more convincing if an employee is underpaid, but not if overpaid, as it may occur in the case of undereducation (Kiker et al. 1997; Verdugo and Verdugo 1989; Verhaest and Omeij 2012).

Given that educational mismatch is defined as the presence of over- or undereducation, and that we anticipate the union membership impact on overeducation to dominate, we can state:

Hypothesis 3. *Trade union members are more likely to be educationally matched than comparable non-members.*

4 | 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. Some analyses, however, include a union membership indicator as one of many right-hand side variables, without discussing the observed correlation in detail.⁸

McGoldrick and Robst (1996) use the 1985 wave of the PSID to estimate determinants of overeducation in the United States. The sign of the estimated coefficient of the union indicator varies with the measure of educational mismatch. Sloane et al. (1996, 1999) present evidence for the British labor market in the mid-1980s. They observe no systematic correlation between trade union membership and overeducation. Similarly, in the study by Wald and Fang (2008), based on data from the 1999 wave of the Canadian Workplace and Employee Survey (WES), overeducation is not significantly correlated with a union indicator.⁹

Fleming and Kler (2008) focus on Australia and utilize the first wave of HILDA. They report a positive correlation between union membership and overeducation. Mavromaras et al. (2009) use the same dataset and indicate that severe overskilling is more frequent among trade union members. Employing the 2004 sweep of the WERS data in the United Kingdom, Belfield (2010) shows that the probability of overeducation tends to be higher among union members than non-members in the private sector, but not in the public sector. 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 native-born individuals, but not for immigrants. Finally, and somewhat in contrast to the insights for Australia, Canada, the United States, and various European countries, Sharma and Sharma (2017) report a negative relationship between union membership and both overeducation and undereducation in India.

In sum, studies for various countries include information about union membership when analyzing educational mismatch. None of these investigations analyze this correlation in detail, and they also tend to focus on overeducation.

5 | Data and Methodology

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

5.1 | 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 are at least one standard deviation above this average are classified as overeducated, while those falling short by at least one standard deviation are classified as undereducated (Clogg and Shockey 1984; Verdugo and Verdugo 1989).

The statistical approach is advantageous compared to other indicators of educational mismatch, such as the indirect

self-assessment or the job analyst measure, as it allows the evaluation of an individual's position in the respective reference group (Capsada-Munsech 2019). It assesses educational mismatch based on labor market demand and supply mechanisms (Hartog 2000), in line with Freeman's (1976) conceptualization of overeducation. Furthermore, the statistical measure automatically adjusts to changes in the labor market and job requirements (Capsada-Munsech 2019; Clogg and Shockey 1984). 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).

Due to rising educational requirements for many jobs and increased participation in higher education, the average level of formal education within specific occupations has likely increased over time as well.¹⁰ To account for this effect, we follow Clogg and Shockey (1984) and Verdugo and Verdugo (1989) and use the mean years of education, \bar{x}_{ot} ,

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

as the benchmark to determine the existence of over- and undereducation, where I_{ot} denotes the number of individuals working in occupation o in survey year t and x_{it} the years of education of individual i .

To define an occupation o , we utilize the ISCO classification based on the question "What is your current position/occupation?"¹¹ 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 the duration of education (in 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 educationally matched and, thus, not classified as overeducated, while those characterized by $x_{it} > \bar{x}_{ot} - s_{ot}$ are not undereducated and, consequently, either overeducated or 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). In turn, years of undereducation are given by $|x_{it} - \bar{x}_{ot} + s_{ot}|$ if $x_{it} - \bar{x}_{ot} + s_{ot} < 0$ holds (and are zero otherwise).

5.2 | Independent Variables

5.2.1 | Trade Union Membership

Our main independent variable stems from the question "Are you a member of one of the following organisations or confederations?", allowing respondents to select either a yes-box or a no-option. The first option is *trade union*.¹² 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 the reunification, in 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019 for respondents throughout Germany.¹³

Since we observe a respondent's union membership broadly every 3 or 4 years, we can identify a change in the membership status if an individual participated in the survey for a sufficient number of waves. However, the data do not allow us to determine the exact timing of the change or to distinguish between single and multiple changes between the observation periods. Moreover, the likelihood of observing a variation in membership is greater for respondents who participate in the survey for longer intervals than for individuals who only answer the questionnaire in a few waves. Finally, the union membership question does not provide information on which trade union an individual belongs to and whether the respondent changed unions.

5.2.2 | Control Variables

We include several independent variables commonly employed in analyses of educational mismatch. The first set focuses on personal characteristics. In particular, we include a dummy variable set equal to one if the respondent is female (e.g., McGoldrick and Robst 1996), a categorical measure of migration status (e.g., Aleksynska and Tritah 2013),¹⁴ variables describing the respondent's age (and age squared divided by 100) (e.g., Di Pietro and Cutillo 2006; Ordine and Rose 2009) and dummy variables indicating civil status (e.g., Groot 1996).¹⁵ As educational mismatch may be related to childcare responsibilities (e.g., Green and McIntosh 2007; Groot 1996), 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-related aspects. Specifically, we include dummy variables for being a white-collar worker (e.g., Duncan and Hoffman 1981) and a civil servant (e.g., Boll et al. 2016), for having experienced unemployment, having a permanent contract (e.g., Turmo-Garuz and Bartual-Figueras 2019), being a full-time employee (e.g., Sloane et al. 1999), as well as firm-size dummies (e.g., Battu et al. 1999), and years of tenure (and tenure squared divided by 100) (e.g., Kiker et al. 1997). Moreover, we incorporate dummies differentiating ten industries as well as nine occupational groups.

5.3 | Estimation Sample

We consider employed individuals and exclude self-employed and solo self-employed individuals, as well as all respondents exceeding their legal retirement age from our sample. Moreover, we drop all observations with missing values. This leaves us with a sample of 65,217 observations from 33,235 individuals for our main estimations.

About 19% of all observations stem from members of a trade union (see Table 1). In our sample, we observe 15,816 individuals

TABLE 1 | Descriptive statistics.

	Mean	SD	Min	Max
Trade union	0.1906	0.3927	0	1
Female	0.4902	0.4999	0	1
Direct migrant	0.1496	0.3567	0	1
Indirect migrant	0.0512	0.2204	0	1
No migrant	0.7992	0.4006	0	1
Age	41.7915	11.4990	17	65
Single	0.2643	0.4410	0	1
Married or partnered	0.6187	0.4857	0	1
Separate or widowed	0.1170	0.3214	0	1
Number of children	1.4891	1.1905	0	12
White-collar	0.5952	0.4909	0	1
Civil servant	0.0566	0.2311	0	1
Prior unemployment	0.3582	0.4795	0	1
Permanent	0.8736	0.3323	0	1
Full-time	0.6985	0.4589	0	1
Public sector	0.2577	0.4374	0	1
Tenure	10.3390	9.9632	0	50.92
Firm size: < 20	0.2251	0.4176	0	1
Firm size: 20–199	0.2890	0.4533	0	1
Firm size: 200–1999	0.2288	0.4200	0	1
Firm size: ≥ 2000	0.2571	0.4370	0	1
<i>N</i>	65,217			

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019.

at least in two waves with union membership information. 2886 individuals changed their union membership status at least once. While, therefore, a sizeable fraction of individuals either join or leave a trade union, we only observe 478 cases of variations in union membership and the educational mismatch status from one wave to the next containing the relevant information.

Table 1 also reports descriptive statistics for some further variables (see Table B1 in Appendix B for a complete documentation). About 49% of the observations stem from females. Respondents are, on average, 41.8 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 5.6% are civil servants. Approximately one third has experienced unemployment. On average, individuals have worked for the same company for around 10 years.

5.4 | Estimation Approach

As years of over- and undereducation are censored at zero from below, we estimate random effects tobit models (Tobin 1958).

Our estimation equation reads

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

Y_{it0} measures years of under- and overeducation of individual i at time t in occupation o . TUM_{it} equals one if a respondent belongs to a trade union and β_2 is the coefficient of interest. X'_{it} is a vector containing personal and job-related controls. We include year and month dummies λ_t and η_m . γ_o captures occupation effects, whereas ξ_s represents the industry fixed effects. v_i includes the individual random effects that are assumed to be independent and identically distributed (i.i.d.), $N(0, \sigma_v^2)$ and ϵ_{it} is the error term, which is assumed to be i.i.d. $N(0, \sigma_\epsilon^2)$ and independent of v_i .

When we analyze the existence of educational mismatch, we estimate random effects logit models of the form:

$$Pr(Y_{it0} \neq 0) = P(\beta_1 + \beta_2 TUM_{it} + \beta_3 X'_{it} + \lambda_t + \eta_m + \gamma_o + \xi_s + v_i + \epsilon_{it}), \quad (3)$$

where Y_{it0} refers to being undereducated, overeducated or educationally matched.

6 | Results

In Section 6.1, we document educational mismatch for trade union members and non-members. This provides first evidence for our hypotheses. Section 6.2 presents the main estimation results and Section 6.3 reports the findings from a number of robustness checks. In Section 6.4, we consider the correlation for various subgroups to derive insights concerning the mechanisms discussed—information and bargaining power—underlying the observed effects.

6.1 | Descriptive Evidence

Table 2 indicates that members of a trade union exhibit, on average, about 1.5 months of overeducation ($=0.1247 \times 12$), while the respective number for non-members equals almost 2 months. Moreover, the probability of being overeducated (educationally matched) is about 2.9 (3.9) percentage points lower (higher) for union members than non-members. Finally, we observe a one percentage point lower probability of being undereducated among trade union members. Therefore, the descriptive evidence is consistent with Hypotheses 1.1, 1.2, and 3 but reveals no evidence of a positive linkage between union membership and undereducation, as suggested by Hypotheses 2.1 and 2.2.

6.2 | Main Findings

Table 3 depicts the estimated coefficients for the union membership dummy for panel random effects tobit specifications (see Equation 2). The dependent variables are years of undereducation in Panel A and years of overeducation in Panel B.¹⁶

The specifications controlling for month and year fixed effects in column 1 reveal a negative correlation between trade

TABLE 2 | Mismatch outcomes by union membership status.

	All		TUM = 0		TUM = 1		t-test
	Mean	SD	Mean	SD	Mean	SD	
Years of undereducation	0.1056	0.3900	0.1065	0.3939	0.1020	0.3733	-0.0045
Years of overeducation	0.1583	0.5962	0.1662	0.6115	0.1247	0.5251	-0.0415***
Undereducated	0.1271	0.3331	0.1291	0.3353	0.1187	0.3234	-0.0104**
Overeducated	0.1314	0.3379	0.1369	0.3437	0.1081	0.3106	-0.0288***
Matched	0.7415	0.4378	0.7340	0.4419	0.7732	0.4188	0.0392***
N	65,217		52,789		12,428		

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019.

** $p < 0.05$.

*** $p < 0.01$.

union membership and years of under- and overeducation. The correlation with undereducation is no longer statistically significant once we control for demographic characteristics. In contrast, the negative correlation between trade union membership and years of overeducation remains qualitatively unaffected by the successive inclusion of additional control variables. Column 5 indicates that union membership is associated with a reduction in the duration of overeducation by 0.15 years (almost 2 months).

Table 4 depicts average marginal effects for panel random effects logit specifications (see Equation 3) relating union membership to the likelihood of undereducation (columns 1 and 2), overeducation (columns 3 and 4), and for being educationally matched (columns 5 and 6). Focusing on the specifications including the full set of control variables in the even-numbered columns, we observe that trade union membership is associated with a 1.3 percentage point lower likelihood of overeducation and an almost 2 percentage points higher likelihood of being matched, while no correlation with undereducation is discernible.¹⁷

In summary, there is less overeducation among trade union members than among non-members, while the probability of being educationally matched is higher among members. These findings are consistent with Hypotheses 1.1, 1.2, and 3, whereas we observe no correlation between union membership and undereducation, as claimed in Hypotheses 2.1 and 2.2.

Turning to other covariates, we observe less overeducation and a higher likelihood of being educationally matched among females and public sector workers, whereas white-collar and permanent employees exhibit less undereducation and more overeducation, with the former correlation dominating, resulting in a higher likelihood of being educationally matched (for related evidence, see, inter alia Aleksynska and Tritah 2013; Belfield 2010; Di Pietro and Cutillo 2006; Green and McIntosh 2007; Jacobs et al. 2021; Kiker et al. 1997; Ordine and Rose 2009; Sloane et al. 1999). For immigrants, we observe the reverse.¹⁸ The relationship between age and the indicators of mismatch is generally nonlinear (for related evidence, see, inter alia Green and McIntosh 2007; Joona et al. 2014). Tables B2 and B3 in Appendix B display the results for all right-hand side variables.

6.3 | Some Robustness Checks

In this section, we report the findings from three robustness checks. The first two cater to concerns that the union membership dummy is correlated with other determinants of educational mismatch that have not adequately been accounted for in Equations (2) and (3). The third robustness check focuses on the comparability of union members and non-union respondents. The findings are documented in Appendix C.

Altering a situation of educational mismatch often involves a job change. If taking up a new job is furthermore correlated with a variation in the union status, the estimated coefficient for the union dummy may partially capture the consequences of a job change. In the specifications presented in Tables 3 and 4 we indirectly account for this possibility as we include tenure as a covariate. We can also tackle this issue directly and use the tenure information to create a dummy variable indicating a job change in the previous year. We then estimate Equations (2) and (3) including the job change indicator and its interaction with the union membership dummy. Results are displayed in Table C1 and Figure C1 in Appendix C. The results for the union membership dummy are qualitatively the same as those reported in Tables 3 and 4. Moreover, the interaction terms are never significantly different from zero. Therefore, we find no evidence that a recent job change affects the relationship between union membership and educational mismatch.

About 40% of employees in Germany work in establishments with co-determination via works councils at the plant level. Since guidelines for the selection of employees for recruitment, transfer, regrading, and dismissal require the approval of the works council, co-determination may affect the extent of educational mismatch. Moreover, the likelihood of union membership is correlated with co-determination (Behrens 2009). Therefore, the union dummy may partially measure the impact of co-determination at the plant level. Because data on union membership and on whether a respondent works in an establishment with a works council is available in the SOEP only in the years 2001, 2011, and 2019, we cannot include the works council information in our main specifications. In order to nevertheless ascertain the works council impact, we first reestimate Equations (2) and (3) for these years. Doing so, we restrict the

TABLE 3 | Panel RE tobit.

	(1)	(2)	(3)	(4)	(5)
<i>Panel A: Years of undereducation</i>					
Trade union	-0.0880*** (0.0281)	-0.0923*** (0.0281)	-0.0807*** (0.0243)	-0.0276 (0.0249)	-0.0267 (0.0252)
<i>Panel B: Years of overeducation</i>					
Trade union	-0.228*** (0.0394)	-0.234*** (0.0395)	-0.155*** (0.0319)	-0.159*** (0.0323)	-0.150*** (0.0340)
Month/year FE	X	X	X	X	X
Federal state FE		X	X	X	X
Occupation/industry FE			X	X	X
Demographics				X	X
Job-related					X
N	65,217	65,217	65,217	65,217	65,217

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. Demographics include dummies for being female, having a direct or indirect migration background, age (level and squared term), dummies for being married or living separately, and the number of kids. Job-related controls incorporate dummies for being a white-collar worker, a civil servant, having experienced unemployment before, owning a permanent contract, working full-time, being a public sector employee, tenure (level and squared term), and three dummies distinguishing firm size. Standard errors presented in parentheses. ***p < 0.01.

sample to individuals who provide valid information on the works council variable and work in establishments with at least five employees, as the relevant law entitles employees to establish works councils only in such establishments. The findings are qualitatively the same as depicted in Tables 3 and 4, indicating that the change in the sample is without impact. In the second step, we add a dummy variable indicating whether an individual works in an establishment with a works council (see Table C2 in Appendix C). The results remain qualitatively unaffected, and if at all, gain in quantitative strength. Therefore, we obtain no evidence that co-determination at the plant level affects the relationship between union membership and educational mismatch.

Tables 3 and 4 and the robustness analyses reported above contain the findings from a correlation analysis. In Germany, there are no certification elections or comparable events that could be interpreted as exogenous variations in trade union membership (see, e.g., DiNardo and Lee 2004; Frandsen 2021). There have not been substantial changes in the costs of union membership, for example, due to a variation in tax-related subsidies of union membership fees, which could be employed as instrumental variables (see, e.g., Barth et al. 2020; Dodini et al. 2021; Dodini, Salvanes, et al. 2023; Dodini, Stansbury, et al. 2023). Therefore, the data do not allow us to supplement the correlation analysis by an investigation of causal effects. However, it seems unlikely that our results are affected by reverse causality, for example, that a decline in overeducation or a greater likelihood of being educationally matched raises the gains from union membership or reduces its costs. Moreover, our findings with respect to overeducation and being educationally matched continue to hold after including extensive sets of demographic and job-related control variables. To further strengthen our findings, we additionally employ an entropy balancing approach (Hainmueller 2012). When reestimating Equations (2) and (3), the results are in line with those presented in Tables 3 and 4 (see Table C3 in Appendix C). This qualitative equivalence also suggests that our specifications are not subject to an omitted variable bias.

6.4 | Heterogeneity

We have argued above that union membership can reduce educational mismatch because it, first, provides individuals with additional information about its consequences and the means to avoid such situations. Second, membership raises the bargaining power in negotiations with the employer and, thus, the expected gains of leaving a job for which an individual is not adequately qualified. To ascertain the relevance of the information and the bargaining power perspective, we subsequently consider the relationship between trade union membership and educational mismatch for subgroups differing in their degree of unionization. The basic idea is that information about the consequences of educational mismatch can have an impact, irrespective of how many other employees belong to the trade union. Hence, if the informational component of union membership affects educational mismatch, no substantial group-specific differences should be discernible. In contrast, the expected costs of voicing discontent are likely to be lower, while the expected gains from leaving, especially a situation of overeducation, are likely to be

TABLE 4 | Panel RE logit: Average marginal effects.

	(1)	(2)	(3)	(4)	(5)	(6)
	Undereducated		Overeducated		Matched	
Trade union	-0.00969*** (0.00298)	-0.00422 (0.00332)	-0.0177*** (0.00316)	-0.0129*** (0.00318)	0.0306*** (0.00474)	0.0188*** (0.00501)
Month and year FE	X	X	X	X	X	X
Further covariates		X		X		X
N	65,217	65,217	65,217	65,217	65,217	65,217

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. The further covariates are the same as those listed in Table 3. Standard errors, clustered at individual level, in parentheses. The average marginal effects account for the discrete change from the base level. *** $p < 0.01$.

greater the more powerful trade unions are. Accordingly, the bargaining power perspective suggests that the union membership effect is stronger among groups of employees with higher unionization rates.

According to our data (see Table D1 in Appendix D for details), union density in Germany is substantially higher among males than females, among full-time compared to part-time employees, in the public than in the private sector, and among blue-collar compared to white-collar workers. Union density in the western part of the country slightly exceeds the share of union members among employees in eastern Germany. Moreover, in two SOEP waves with union membership data, there is information about collective bargaining coverage (i.e., in 2015 and 2019). We observe that union density is higher for employees covered by a collective bargaining agreement than for those who are uncovered.

To analyze the impact of union density we, furthermore, define $2^5 = 32$ groups of employees according to the respondent's gender, working time, sector, place of residence, and occupation.¹⁹ For each group, we calculate union density, dividing the number of union members by the number of employees, leveraging the sample described in Section 5.3. The levels of union density computed in this manner range from 7.55% for the group of female, part-time, white-collar workers in the West German private sector, to 43.6% for the group of full-time, male, blue-collar workers in the West German public sector. The value closest to the median accounts for 42.57% of the cumulative distribution and yields a density of 15.27%. Groups of employees featuring a density below the level of 42.57% are considered low-density and those above as high-density groups of employees. Given these distinctions, we estimate Equation (3) separately for each of the $6 \times 2 = 12$ subgroups enumerated in the previous paragraph and for the subgroups of high- and low-density employees as defined above.

Table 5 depicts the average marginal effects from panel RE logit specifications. The results summarized in Table 4 for the entire sample concerning the relationship between union membership and overeducation, respectively (mis-)match, can qualitatively also be observed for the subgroups of males, full-time and private sector employees, individuals residing in western Germany, and high-density employees. Trade union members covered by a collective wage agreement or in a blue-collar job are less likely to

be undereducated and more likely to be educationally matched than their non-member counterparts. Finally, for white-collar employees, union membership is associated with an increase in the probability of being educationally matched by about the same magnitude as for blue-collar members.²⁰

By comparing the different subgroups, we find a negative correlation between trade union membership and overeducation as well as a positive one with the probability of being educationally matched for some employees but not for others. This suggests that the relationship is not due to informational advantages of union members, as it seems implausible that trade unions could restrict information on how to avoid educational mismatch, for example, according to gender or working time. The evidence from Table 5 is more in line with the bargaining power perspective. This is evident from our observation of significant positive correlations between union membership and being educationally matched among males, full-time employees, blue-collar workers, and for individuals covered by a collective wage agreement. In addition, the likelihood of being overeducated is lower among males and full-time workers. In all of these subgroups, union membership is relatively widespread. The findings for the group of high-density employees in Panel G of Table 5 support this interpretation.

The nonsignificant correlations for the public sector do not necessarily refute the bargaining power argument, as the consequences of overeducation and the role of union membership may differ in the public compared to the private sector. First, educational mismatch is less prevalent in the public sector (see Tables B2 and B3 in Appendix B). Second, job descriptions in the public sector are usually relatively detailed, and the minimum level of qualification must be stated precisely. Moreover, the payment scheme is much more transparent in the public sector compared to the private sector (Deutscher Bundestag 2019a, 2019b). Therefore, the informational advantages associated with union membership are likely to be smaller than in the private sector. Third, promotion in the public sector often involves strong elements of experience or tenure. Moreover, the qualification requirements for promotions are usually non-negotiable and apply to all applicants for a vacant position. Accordingly, the impact of bargaining power is likely to be less relevant. Consequently, both the informational benefits of union membership and the resulting bargaining power may play a lesser role in the public than in the private sector, and the scope for union membership

TABLE 5 | Heterogeneity—Panel RE logit: Average marginal effects.

	(1)		(2)		(3)		(4)		(5)		(6)	
	Undereducated		Undereducated		Overeducated		Overeducated		Matched		Matched	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Panel A: Gender												
Trade union	-0.00263 (0.00433)	-0.00361 (0.00521)	-0.0176*** (0.00466)	-0.00452 (0.00447)	0.0186*** (0.00663)	0.0107 (0.00777)						
N	33,249	31,968	33,249	31,968	33,249	31,968	33,249	31,968	33,249	31,968	33,249	31,968
Panel B: Working time												
Trade union	-0.00677 (0.00746)	-0.00336 (0.00367)	-0.00760 (0.00629)	-0.0142*** (0.00398)	0.0143 (0.00984)	0.0181*** (0.00560)						
N	19,664	45,553	19,664	45,553	19,664	45,553	19,664	45,553	19,664	45,553	19,664	45,553
Panel C: Sector												
Trade union	-0.00559 (0.00407)	-0.00446 (0.00582)	-0.0176*** (0.00378)	-0.00170 (0.00572)	0.0239*** (0.00603)	0.00928 (0.00872)						
N	48,408	16,809	48,408	16,809	48,408	16,809	48,408	16,809	48,408	16,809	48,408	16,809
Panel D: Region												
Trade union	-0.00322 (0.00378)	-0.00557 (0.00598)	-0.0160*** (0.00379)	-0.00789 (0.00530)	0.0203*** (0.00565)	0.0138 (0.0108)						
N	51,510	13,707	51,510	13,707	51,510	13,707	51,510	13,707	51,510	13,707	51,510	13,707
Panel E: Occupation												
Trade union	-0.0126*** (0.00487)	-0.000529 (0.00414)	-0.00621 (0.00442)	-0.00397 (0.00401)	0.0171** (0.00678)	0.0153** (0.00703)						
N	26,401	38,816	26,401	38,816	26,401	38,816	26,401	38,816	26,401	38,816	26,401	38,816
Panel F: Coll. bargaining												
Trade union	-0.00821 (0.0135)	-0.0152** (0.00654)	0.000292 (0.00986)	-0.00265 (0.00669)	0.00933 (0.0196)	0.0219** (0.00956)						
N	9175	12,204	9175	12,204	9175	12,204	9175	12,204	9175	12,204	9175	12,204
Panel G: Union density												
Trade union	-0.00340 (0.00351)	-0.00870 (0.00601)	-0.0133*** (0.00399)	-0.00449 (0.00501)	0.0186*** (0.00584)	0.0117 (0.00912)						
N	38,123	27,094	38,123	27,094	38,123	27,094	38,123	27,094	38,123	27,094	38,123	27,094

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019 for Panels A-E and G and from 2015 and 2019 for Panel F. The further covariates are the same as those explained in Table 3 except for gender in Panel A, full-time in Panel B, public sector in Panel C, and white collar in Panel E. Standard errors, clustered at individual level, presented in parentheses.
 **p < 0.05.
 ***p < 0.01.

effects may be smaller. This, in turn, implies that the irrelevance of individual union membership for educational (mis-)match in the highly unionized public sector, as depicted in Panel C of Table 5, can be consistent with the role of bargaining power.

In sum, the subgroup analysis is largely compatible with the hypothesis that the bargaining power of union members is enhanced by a high percentage of members among employees, which, in turn, enables members of such high-density employee groups to avoid the adverse consequences of educational mismatch. Our investigation, however, finds no evidence that trade union members are better informed about the causes and consequences of educational mismatch compared to non-members.

7 | Conclusion

We hypothesize that the probability of overeducation and its extent are lower among union members. Conversely, we expect undereducation to be higher among union members. Moreover, we anticipate the overeducation effect to dominate, implying that union members are more likely to be educationally matched than comparable non-members.

Using data from the German Socio-Economic Panel (SOEP) for the period 1985–2019, we obtain evidence for a negative correlation between an employee's trade union membership and the incidence of overeducation. We also find that union members exhibit a significantly lower extent of overeducation and a greater likelihood of being educationally matched than non-members. These relationships can be observed, in particular, for males, full-time and private sector employees, individuals residing in western Germany, and respondents working in high union-density surroundings. They are not discernible for females, part-time or public sector employees, and residents of Eastern Germany. As informational advantages of trade union membership would apply uniformly, irrespective of union coverage, the evidence is not consistent with an informational role of union membership but rather supports the bargaining power effect. We cannot identify a robust linkage between union membership and undereducation.

To illustrate the quantitative importance of the effects, the subsequent back-of-envelope calculation may be informative. According to Table 2, 13.14% of respondents are overeducated, with an average duration of overeducation in the entire sample of 0.1583 years. By definition, undereducated and educationally matched individuals have zero years of overeducation. Therefore, each overeducated respondent has, on average, a (uncompleted) duration of overeducation of about 1.2 (=0.1583/0.1314) years. Union membership is associated with a reduction in the duration of overeducation by 0.150 years or 54.75 days, which represents a decrease of 15.2%. Consider this scenario: If the private costs of overeducation account for 5% of the annual gross wage (e.g., Chu Ng 2003), a union member would experience a reduction in these costs of more than 0.75% ($5\% \times 0.150$) of their gross wage. Since the membership fee amounts to 1% of the gross wage, mitigating the negative impacts of educational mismatch can serve as a compelling incentive to join a trade union.

Other analyses that consider trade union membership as one of many determinants of educational mismatch predominantly observe positive correlations. Our findings indicate a negative correlation between union membership and both overeducation and educational mismatch. Whether this difference in findings is due to specific characteristics of the German labor market, trade unions having a different role compared to other countries, or differences in considered employee groups are all issues that we cannot tackle with the data at hand.

While the SOEP data allow for a thorough investigation of the issue under scrutiny, they also have their limitations, as we indicated above. Most importantly, since information on union membership is only available for selected waves of SOEP data, we cannot identify the year an employee joined or left a trade union. Moreover, observed changes in union membership status and situations of educational mismatch are relatively rare. As a result, our data do not enable us to identify fixed effects specifications.

Data Availability Statement

The data that support the findings of this study are available from DIW, Berlin (SOEP). Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the author(s) with the permission of DIW, Berlin (SOEP).

Endnotes

- ¹ The pertinent analyses have looked at socio-demographic factors, such as gender (e.g., McGoldrick and Robst 1996; Santiago-Vela and Mergener 2022), migration background (e.g., Akgüç and Parasnis 2023; Aleksynska and Tritah 2013), and educational aspects, including grades, college quality or 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 the composition of the labor market (e.g., Davia et al. 2017; Tarvid 2015).
- ² 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.
- ³ See, for example, the websites of the Railroad and Transport Union, EVG (<https://www.evg-online.org/deine-vorteile/unsere-leistungen/>) and the Mining, Chemical and Energy Industrial Union, IG BCE (<https://igbce.de/igbce/werde-mitglied>).
- ⁴ See the website <https://www.lohnspiegel.de>.
- ⁵ See the website <https://www.igmetall.de/mitglieder>.
- ⁶ 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 Omeij 2010) because they might provide their children with better information regarding their labor market integration as well as with higher social capital in the form of work-related networks.
- ⁷ Sloane et al. (1999) argue that trade unions may entice employers to change job specifications and recruiting behavior to reduce educational mismatch. Such an effect would have the same consequences as lower costs of requesting a better match.
- ⁸ Other studies consider correlations between educational mismatch and union density (Aleksynska and Tritah 2013; Davia et al. 2017) or collective bargaining coverage (Jacobs et al. 2021).

- ⁹ Wald and Fang (2008) do not distinguish between individual trade union membership and bargaining coverage.
- ¹⁰ The educational expansion is substantial in Germany. Official labor market data show an increase in higher education graduates from 227,525 in 1998 to 505,650 in 2022 (Statistisches Bundesamt 2021, 2023).
- ¹¹ The SOEP provides ISCO classifications in two versions 88 and 08, which need to be combined. While some occupational groups remained unaffected from the adaptation, others were recoded in the adapted version (see International Labour Office 2012). To ensure consistency and currency, we use the adapted ISCO-08 classification in these cases.
- ¹² 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. The wording of the question and the list of organizations or confederations vary somewhat over time. The SOEP always provides the option *trade union*.
- ¹³ Information on union membership is additionally available in 1990 for respondents from east Germany. We do not include data from this wave in our basic specification because the wave does not contain data on all the confounding factors listed in the next paragraph.
- ¹⁴ 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.
- ¹⁵ We differentiate individuals living together in any kind of relationship, such as marriage or registered partnership, individuals living separate, 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.
- ¹⁶ For alternative measures of educational mismatch, such as Indirect Self-Assessment (ISA), Job Analyst measure (JA), and an extended statistical measure (Duncan and Hoffman 1981; Jacobs et al. 2021; Rumberger 1981a, 1981b), we obtain qualitatively similar results as reported in Table 3.
- ¹⁷ The results in Tables 3 and 4 remain unaffected by incorporating labor market experience instead of tenure or dummy variables for education levels, and expanding the sample through the 1990-wave, while excluding details about contract duration.
- ¹⁸ This result can be explained by the definition of overeducation being based on the years spent in formal education. The data reveal that among natives 33% have 13 or more years of formal education, while the same holds for about 13% of direct migrants.
- ¹⁹ We do not incorporate collective bargaining in order to use observations for the entire time period.
- ²⁰ If we estimate tobit specifications, the results for the subgroups considered in Panels A–C and F, G are qualitatively the same. For white-collar workers (Panel E), we find a significant negative correlation between trade union membership and overeducation in the tobit specification. In addition, we observe a negative correlation between union membership and overeducation for individuals living in eastern Germany (Panel D).
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Appendix A

Trends in Educational Mismatch

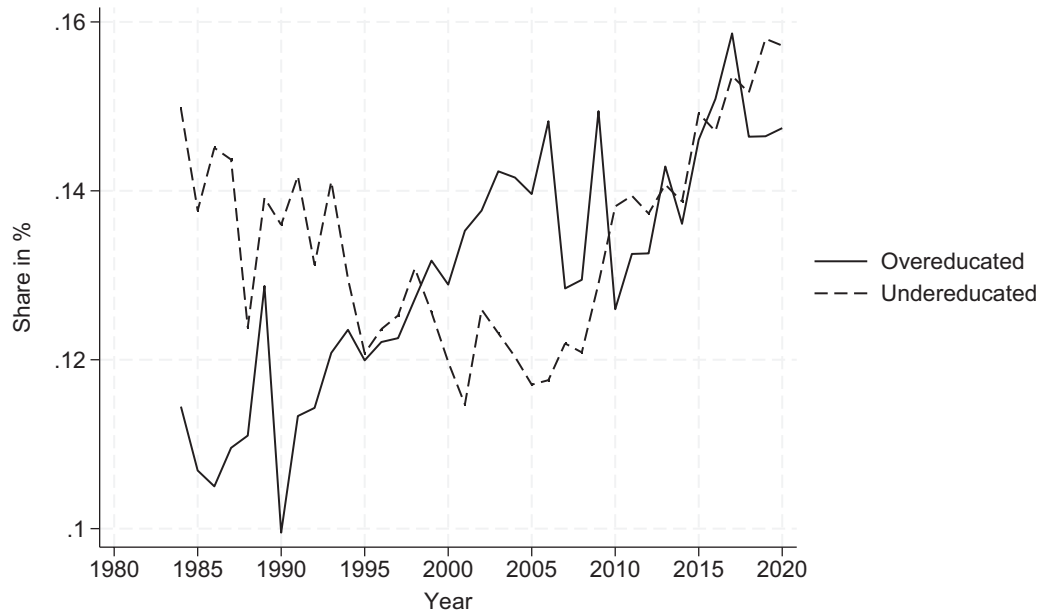


FIGURE A1 | Percentage of overeducated and undereducated individuals in Germany: 1984–2020. This graph illustrates the percentage of overeducated (undereducated) individuals as determined by the statistical approach, utilizing all available SOEP waves spanning from 1984 to 2020. Individuals who are older than the legal retirement age, those unemployed, and (solo-) self-employed are excluded.

Appendix B

TABLE B1 | Extended summary statistics differentiated by trade union membership.

	All		TUM=0		TUM=1		t-test
	Mean	SD	Mean	SD	Mean	SD	
Trade union	0.1906	0.3927					
Female	0.4902	0.4999	0.5244	0.4994	0.3449	0.4753	-0.180***
Direct migrant	0.1496	0.3567	0.1508	0.3578	0.1447	0.3518	-0.0061
Indirect migrant	0.0512	0.2204	0.0537	0.2255	0.0405	0.1971	-0.0133***
No migrant	0.7992	0.4006	0.7955	0.4034	0.8149	0.3884	0.0194***
Age	41.7915	11.4990	41.2406	11.5680	44.1317	10.8955	2.891***
Single	0.2643	0.4410	0.2792	0.4486	0.2009	0.4007	-0.0783***
Married or partnered	0.6187	0.4857	0.6038	0.4891	0.6821	0.4657	0.0783***
Separate or widowed	0.1170	0.3214	0.1170	0.3214	0.1170	0.3214	0.0000
Number of children	1.4891	1.1905	1.4791	1.2012	1.5313	1.1428	0.0522***
White-collar	0.5952	0.4909	0.6295	0.4829	0.4493	0.4974	-0.180***
Civil servant	0.0566	0.2311	0.0453	0.2079	0.1048	0.3063	0.0595***
Prior unemployment	0.3582	0.4795	0.3852	0.4867	0.2432	0.4291	-0.142***
Permanent	0.8736	0.3323	0.8607	0.3462	0.9283	0.2580	0.0676***
Full-time	0.6985	0.4589	0.6682	0.4709	0.8273	0.3780	0.159***
Public sector	0.2577	0.4374	0.2390	0.4265	0.3371	0.4728	0.0981***
Tenure	10.3390	9.9632	9.2426	9.3176	14.9962	11.1959	5.754***
Firm size: <20	0.2251	0.4176	0.2605	0.4389	0.0747	0.2629	-0.186***
Firm size: 20-199	0.2890	0.4533	0.3045	0.4602	0.2235	0.4166	-0.0809***
Firm size: 200-1999	0.2288	0.4200	0.2166	0.4119	0.2804	0.4492	0.0638***
Firm size: ≥2000	0.2571	0.4370	0.2184	0.4132	0.4214	0.4938	0.203***
Ind: Agriculture	0.0119	0.1083	0.0134	0.1151	0.0052	0.0721	-0.00820***
Ind: Energy	0.0097	0.0982	0.0084	0.0910	0.0156	0.1240	0.00726***
Ind: Manufacturing	0.2641	0.4408	0.2359	0.4246	0.3838	0.4863	0.148***
Ind: Mining	0.0034	0.0584	0.0016	0.0399	0.0112	0.1052	0.00959***
Ind: Construction	0.0608	0.2389	0.0651	0.2467	0.0424	0.2015	-0.0227***
Ind: Trade	0.1440	0.3511	0.1590	0.3657	0.0804	0.2719	-0.0786***
Ind: Transport	0.0512	0.2204	0.0415	0.1994	0.0926	0.2899	0.0511***
Ind: Bank	0.0398	0.1956	0.0442	0.2056	0.0212	0.1439	-0.0231***
Ind: Services	0.3837	0.4863	0.4003	0.4900	0.3129	0.4637	-0.0874***
Ind: Other	0.0314	0.1743	0.0306	0.1722	0.0347	0.1830	0.00409*
ISCO: LegSenOfMan	0.0448	0.2069	0.0476	0.2128	0.0332	0.1792	-0.0143***
ISCO: Prof	0.1399	0.3469	0.1444	0.3515	0.1209	0.3260	-0.0235***
ISCO: TechAssProf	0.2487	0.4323	0.2530	0.4347	0.2305	0.4212	-0.0225***
ISCO: Clerks	0.1293	0.3356	0.1336	0.3403	0.1110	0.3142	-0.0226***
ISCO: Service	0.1224	0.3278	0.1323	0.3388	0.0805	0.2721	-0.0518***
ISCO: AgriculFish	0.0079	0.0886	0.0084	0.0912	0.0059	0.0764	-0.00252**
ISCO: CraftTrade	0.1467	0.3539	0.1309	0.3373	0.2141	0.4102	0.0832***
ISCO: PlantMachine	0.0810	0.2728	0.0675	0.2509	0.1382	0.3451	0.0706***
ISCO: Elementary	0.0791	0.2700	0.0823	0.2748	0.0657	0.2477	-0.0167***
N	65,217		52,789		12,428		

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

TABLE B2 | Panel RE tobit - Extended results.

Years of ...	(1)	(2)	(3)	(4)
	Undereducation		Overeducation	
Trade union	-0.0880*** (0.0281)	-0.0267 (0.0252)	-0.228*** (0.0394)	-0.150*** (0.0340)
Female		0.000482 (0.0281)		-0.170*** (0.0387)
Direct migrant		1.283*** (0.0328)		-1.019*** (0.0559)
Indirect migrant		0.564*** (0.0500)		-0.374*** (0.0751)
Age		-0.0970*** (0.00615)		0.0809*** (0.00801)
Age (Sq/100)		0.115*** (0.00705)		-0.0975*** (0.00928)
Married or partnered		-0.000208 (0.0321)		-0.143*** (0.0365)
Separate or widowed		0.102** (0.0416)		-0.332*** (0.0514)
Number of children		0.0621*** (0.0111)		-0.0477*** (0.0155)
White collar		-0.565*** (0.0262)		0.665*** (0.0361)
Civil servant		-1.241*** (0.0610)		0.875*** (0.0814)
Prior unemployment		-0.0135 (0.0250)		0.0609* (0.0326)
Permanent		-0.221*** (0.0271)		0.104*** (0.0343)
Full-time		-0.163*** (0.0233)		0.0759*** (0.0291)
Public sector		0.0758*** (0.0270)		-0.128*** (0.0337)
Tenure		0.00630** (0.00291)		-0.0312*** (0.00375)
Tenure (Sq/100)		0.0161** (0.00787)		0.0257** (0.0113)
Firm size: 20–199		-0.0299 (0.0250)		0.112*** (0.0319)
Firm size: 200–1999		-0.0569** (0.0278)		0.159*** (0.0359)
Firm size: ≥ 2000		-0.112*** (0.0288)		0.272*** (0.0371)
Month and year FE	X	X	X	X
<i>N</i>	65,217	65,217	65,217	65,217

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. Further covariates (not displayed): Dummies indicating federal state, industries, and occupation. Standard errors in parentheses.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

TABLE B3 | Panel RE logit: Average marginal effects - Extended results.

	(1)	(2)	(3)	(4)	(5)	(6)
	Undereducated		Overeducated		Matched	
Trade union	-0.00969*** (0.00298)	-0.00422 (0.00332)	-0.0177*** (0.00316)	-0.0129*** (0.00318)	0.0306*** (0.00474)	0.0188*** (0.00501)
Female		-0.00256 (0.00344)		-0.0165*** (0.00305)		0.0264*** (0.00506)
Direct migrant		0.186*** (0.00602)		-0.0669*** (0.00368)		-0.124*** (0.00692)
Indirect migrant		0.0658*** (0.00683)		-0.0269*** (0.00524)		-0.0446*** (0.00955)
Age		-0.0140*** (0.000870)		0.00393*** (0.000808)		0.0118*** (0.00127)
Age (Sq/100)		0.0166*** (0.000997)		-0.00450*** (0.000948)		-0.0146*** (0.00148)
Married or partnered		0.000852 (0.00420)		-0.0140*** (0.00365)		0.0230*** (0.00615)
Separate or widowed		0.0171*** (0.00552)		-0.0332*** (0.00510)		0.0300*** (0.00815)
Number of children		0.00743*** (0.00135)		-0.00358*** (0.00121)		-0.00443** (0.00201)
White collar		-0.0792*** (0.00375)		0.0680*** (0.00386)		0.0154*** (0.00538)
Civil servant		-0.152*** (0.00810)		0.0831*** (0.00702)		0.0735*** (0.0114)
Prior unemployment		-0.00712** (0.00323)		0.00972*** (0.00276)		-0.00359 (0.00472)
Permanent		-0.0348*** (0.00367)		0.0166*** (0.00365)		0.0232*** (0.00566)
Full-time		-0.0230*** (0.00322)		0.00382 (0.00287)		0.0269*** (0.00480)
Public sector		0.00859** (0.00357)		-0.0148*** (0.00343)		0.0102* (0.00558)
Tenure		0.00116*** (0.000411)		-0.00232*** (0.000393)		0.00217*** (0.000614)
Tenure (Sq/100)		0.00171 (0.00109)		0.000561 (0.00116)		-0.00454*** (0.00172)
Firm size: 20–199		-0.00533 (0.00342)		0.00854*** (0.00316)		-0.00273 (0.00515)
Firm size: 200–1999		-0.00643* (0.00378)		0.0164*** (0.00363)		-0.0142** (0.00576)
Firm size: ≥ 2000		-0.0154*** (0.00391)		0.0270*** (0.00363)		-0.0148** (0.00584)
Month and year FE	X	X	X	X	X	X
N	65,217	65,217	65,217	65,217	65,217	65,217

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. Further covariates (not displayed): Dummies indicating federal state, industries and occupation. Standard errors, clustered at individual level, in parentheses. The average marginal effects account for the discrete change from the base level.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

Appendix C

Robustness Checks

TABLE C1 | Panel RE logit: Trade union interaction with job switching.

	(1)	(2)	(3)
	Undereducated	Overeducated	Matched
Trade union	-0.0991 (0.0951)	-0.335*** (0.0923)	0.202*** (0.0614)
Job switching	0.0185 (0.0690)	-0.0428 (0.0619)	0.0321 (0.0437)
Trade union × job switching	-0.0233 (0.152)	0.0397 (0.132)	-0.00701 (0.0935)
Month and year FE	X	X	X
Further covariates	X	X	X
<i>N</i>	65,217	65,217	65,217

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. Job switching is identified based on tenure. Due to the interaction term, Table C.1 does report point estimates. Average marginal effects are displayed in Figure C1. The further covariates are the same as those listed in Table 3. Standard errors, clustered at individual level, in parentheses.

*** $p < 0.01$.

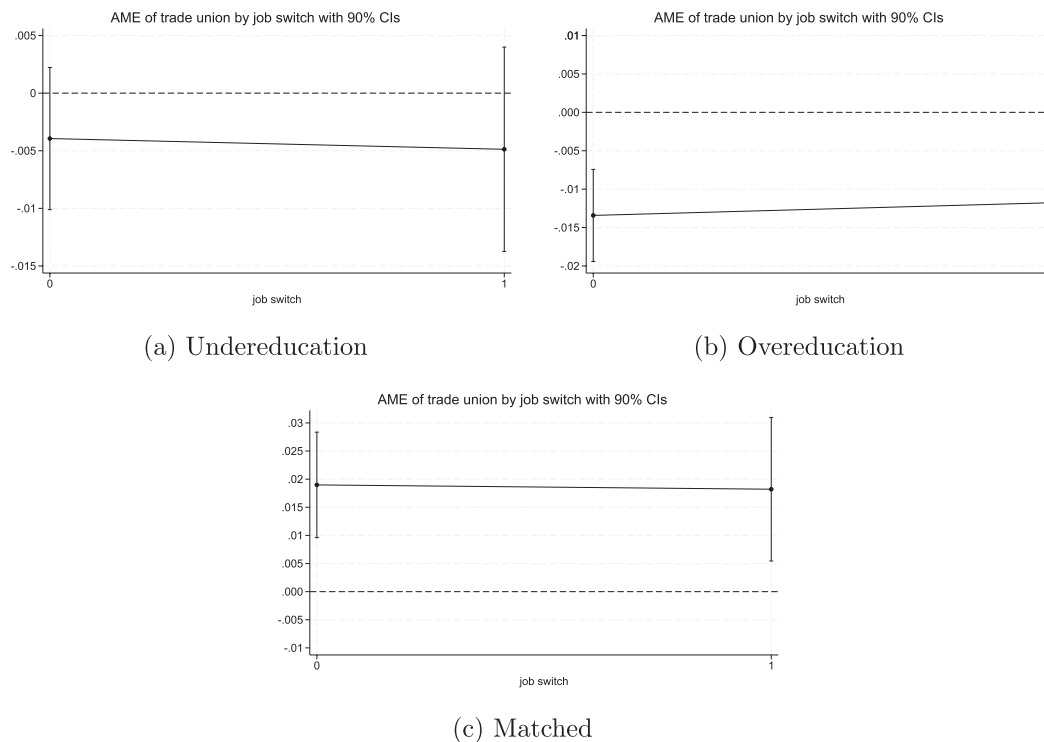


FIGURE C1 | Panel RE logit trade union interaction with job switching: average marginal effects. The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. This figure displays average marginal effects of the interaction between trade union membership and job switching identified based on tenure. The average marginal effects account for the discrete change from the base level. 90% confidence intervals are plotted.

TABLE C2 | Panel RE logit: Including works council information.

	(1)	(2)	(3)	(4)	(5)	(6)
	Undereducated		Overeducated		Matched	
Trade union	-0.00932 (0.00600)	-0.00880 (0.00607)	-0.0227*** (0.00649)	-0.0245*** (0.00647)	0.0324*** (0.00864)	0.0342*** (0.00869)
Council exists		-0.00391 (0.00573)		0.0125** (0.00580)		-0.0130 (0.00812)
Month and year FE	X	X	X	X	X	X
Further covariates	X	X	X	X	X	X
<i>N</i>	20,070	20,070	20,070	20,070	20,070	20,070

Note: The sample is based on SOEP data from 2001, 2011, and 2019. The further covariates are the same as those listed in Table 3. Standard errors, clustered at individual level, in parentheses. The average marginal effects account for the discrete change from the base level.

** $p < 0.05$.

*** $p < 0.01$.

TABLE C3 | Logit with entropy balancing weights: Average marginal effects.

	(1)	(2)	(3)
	Undereducated	Overeducated	Matched
Trade union	-0.00615 (0.00525)	-0.0110** (0.00512)	0.0178** (0.00690)
Month and year FE	X	X	X
Further covariates	X	X	X
<i>N</i>	33,235	33,235	33,235

Note: The sample is based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019. To avoid biases from non-constant weights within individuals, the sample is restricted to the first observation per individual and a cross-sectional logit is estimated. The entropy balancing weights are estimated based on gender, migration background, age, civil status, and the number of children. The further covariates are the same as those listed in Table 3. Standard errors, clustered at individual level, in parentheses. The average marginal effects account for the discrete change from the base level.

** $p < 0.05$.

Appendix D

Heterogeneity Analysis

TABLE D1 | Trade union density among various groups of employees.

Panel A: Gender	<i>Males</i>	<i>Females</i>
	24.49%	13.41%
	33,249	31,968
Panel B: Working time	<i>Part-time</i>	<i>Full-time</i>
	10.91%	22.57%
	19,664	45,553
Panel C: Sector	<i>Private</i>	<i>Public</i>
	17.02%	24.93%
	48,408	16,809
Panel D: Region	<i>West</i>	<i>East</i>
	19.42%	17.69%
	51,510	13,707
Panel E: Occupation	<i>Blue-collar</i>	<i>White-collar</i>
	25.92%	14.39%
	26,401	38,816
Panel F: Coll. bargaining	<i>Uncovered</i>	<i>Covered</i>
	6.30%	22.62%
	9,175	12,204

Note: Own calculations based on SOEP data from 1985, 1989, 1993, 1998, 2001, 2003, 2007, 2011, 2015, and 2019 for Panels A–E and from 2015 to 2019 for Panel F.