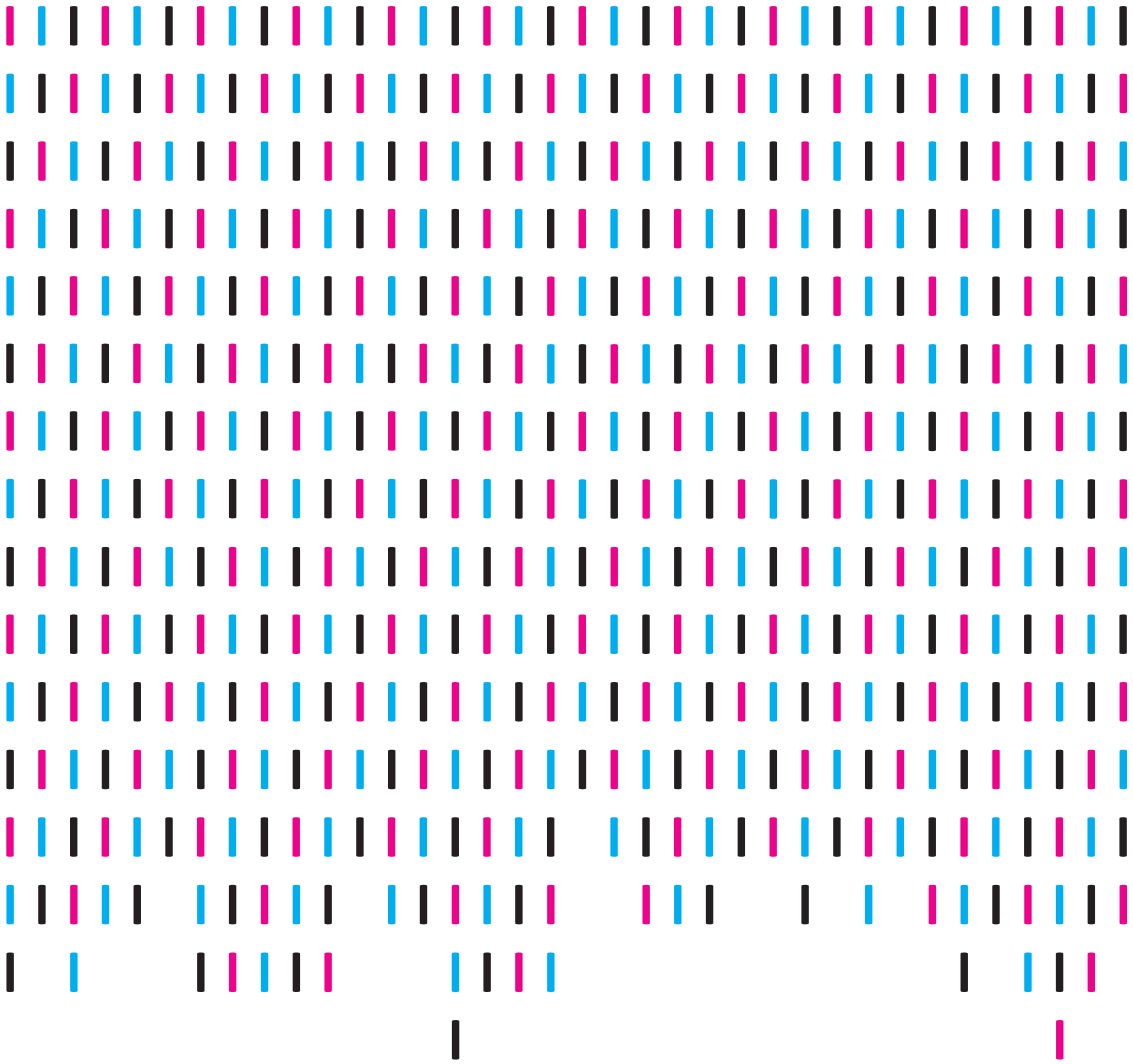

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WAGE LOSSES DUE TO OVER-QUALIFICATION: THE ROLE OF FORMAL DEGREES AND OCCUPATIONAL SKILLS

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Wage Losses Due to Overqualification:

The Role of Formal Degrees and Occupational Skills

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Wage Losses Due to Overqualification: The Role of Formal Degrees and Occupational Skills

Abstract

Wage penalties in overqualified employment are well documented, but little is known regarding the underlying mechanisms. Drawing on new methods to measure the mismatch between jobs and qualifications, we test two explanations, namely, formal overqualification and a mismatch of occupational skills. By using the National Educational Panel Study (NEPS) sur-vey that is linked to German administrative data, we can objectively measure both types of mismatches. By using fixed-effects models, we confirm that overqualification is associated with a wage loss of approximately 5 percent, which indicates penalties from a lower requirement level. We find that some of this wage loss can be explained by a mismatch of skills be-tween the current and training occupation. Further analyses show that mismatches of occupational skills explain the wage loss of formal overqualification of employees with vocational training. For academics, both types of mismatch are unrelated. We conclude that because of occupational boundaries and more specific occupational skills, the people who are overqualified with vocational training more often work in jobs with lower and different skill requirements. We emphasize that measuring occupational skills and their mismatch allows for a deeper understanding of overqualification and wage-setting.

Keywords

Overqualification, occupational skills, mismatch, wages

JEL Classification

I21, I26, J24, J31

1. Introduction

The relevance of labor market mismatches has been emphasized in numerous studies as one of the factors for negative labor market outcomes. If a person's job does not match his/her qualifications, the acquired human capital cannot be utilized entirely and therefore converted into expected returns because he/she is not optimally productive in this job. Consequently, previous findings largely agree that overqualification – when a person's level of formal qualification exceeds the job requirements – leads to individual drawbacks and, particularly, wage penalties (e.g. Malcolm Brynin & Longhi, 2009; Hartog & Sattinger, 2013; Levels, Van der Velden, & Allen, 2014; Quintini, 2011; Szydlik, 1996). With an average of almost 22 percent in member countries of the Organisation for Economic Cooperation and Development (OECD), overqualification affects a considerable proportion of the total workforce (OECD, 2016).

Although sociological and economic researchers have addressed this topic for decades, recent years have provided a clear impetus for research on labor market mismatches. Because of improved data, it has become possible to differentiate between formal qualification mismatches and the mismatches between an individual's set of skills and the skills that are required for a certain job. Recent empirical studies conclude that formal qualification mismatch and skills mismatch are not necessarily the same phenomenon (Allen, Levels, & van der Velden, 2013; Allen & van der Velden, 2001; Flisi, Goglio, Meroni, Rodrigues, & Vera-Toscano, 2017; McGowan & Andrews, 2015). Employees can be formally well-matched but mismatched regarding skills (and vice versa). Accordingly, the studies that simultaneously analyze both types of mismatch state that each type can contribute to lower wages (compare Allen & van der Velden, 2001; Levels et al., 2014).[1] However, thus far, the empirical studies that explicitly measure skills mismatch mostly use test-based literacy or numeracy scores to approximate an individual's set of skills (for example Desjardins & Rubenson, 2011; Flisi et al., 2017; Levels et al., 2014; McGowan & Andrews, 2015; Pellizzari & Fichen, 2013). Therefore, these studies can only focus on broad skill measures or general human capital. The demand for specific skills, however, should vary by occupation, because human capital is mostly specific to industry and occupation (Kambourov & Manovskii, 2008, 2009). This specificity suggests that a large part of mismatches should refer to occupation-specific skills rather than general cognitive skills. Previous research has thus potentially left a major source of mismatch unobserved, which should be closely linked to formal overqualification.

We draw on a new method to measure occupational skills and compare trained occupational skills and skill requirements by the current occupation. We first examine if both formal overqualification and a mismatch of occupational skills negatively affect wages. Second, we are interested in the extent to which the negative wage effect of formal overqualification can be explained by a mismatch of occupational skills. A focus on the mismatch of occupational skills has further implications. The proportion of general and occupation-specific human capital should vary between academic and vocational training. Vocational training often follows standardized skill requirements, whereas academic training on average entails more general cognitive skills. We thus assume that the type of training affects the potential transferability of skills when changing occupations. Therefore, we offer a more nuanced view

1 For further examinations of wage effects by different measures of overqualification, see Chevalier (2003), Chevalier and Lindley (2009) and Green and Zhu (2010).

of the effects of overqualification on wage penalties and assume different underlying mechanisms that depend on the type of training.

To analyze the role of formal degrees and occupational skills, we use the longitudinal survey dataset of the National Educational Panel Study (NEPS), which is linked to the administrative data of the German Federal Employment Agency. We can thus calculate an objective measure of formal overqualification and compare the highest attained qualification degree of an employee with the required level of this employee's job. To measure the mismatch of occupational skills, we use a newly developed similarity index, which is based on an expert database that is provided by the German Federal Employment Agency. This index captures the amount of overlapping core requirements between two occupations. With this index, we directly compare the similarity between the currently observed occupation of an employee and his/her training occupation in which he/she attained the relevant occupation-specific skills. We can also provide a dynamic perspective and measure the effects of formal overqualification and a mismatch of occupational skills with fixed-effects panel regressions. Although previous studies have mostly used cross-sectional designs, we can identify the effects of overqualification on wages through job changes. We can thus control for unobserved individual heterogeneity, which is likely to simultaneously affect wages and the probability of being overqualified.

Our results show that formal overqualification has a severe negative effect on wages, but individual heterogeneity explains approximately half of this effect. Furthermore, parts of this effect can be explained by a mismatch of occupational skills. Both types of mismatch thus negatively affect wages, but lower wages that are due to formal overqualification can partly be ascribed to the mismatches between occupational skills and skill demands. Further analyses show that academics face wage losses that are mainly caused by formal overqualification, whereas overqualified workers with vocational training face wage losses that are mostly due to a mismatch of occupational skills. We conclude that the vocational system provides more occupation-specific skills and that stricter boundaries between respective occupations allow fewer skills to be transferred among jobs.

2. Overqualification, Skills Mismatch and Their Impact on Wages

Overqualification in its general sense means that a person's level of qualification exceeds their job requirements. Traditionally, in the literature on labor market mismatches, these qualifications were understood as formal educational or qualification degrees (compare Büchel, 2001; Chevalier, 2003; Hartog, 2000; Leuven & Oosterbeek, 2011). However, the simple comparison between formal qualification levels and job requirements ignores one crucial fact: employees who provide fewer relevant or other skills than the job requires can still be considered adequately qualified if they hold the respective degree. Likewise, employees who are formally overqualified may be a perfect match regarding demanded and supplied skills (for example Allen & van der Velden, 2001; Chevalier & Lindley, 2009; Green & McIntosh, 2007; Levels et al., 2014; Pellizzari & Fichen, 2013). This differentiated view separates the explanations of formal overqualification and the mismatches between employees' sets of skills and the skills that are required in their jobs. By comparing 17 European Union Member States with data from the Programme for the International Assessment of Adult Competencies (PIAAC), Flisi et al. (2017) contrast several measurement approaches for qualifications and skills mismatch. They show that there are employees who

are formally overqualified but are a good match regarding skills (in Germany, approximately 12 percent) and employees who are formally in adequate employment but have a skills mismatch (in Germany, 22 percent) (ibid.). Across OECD countries, approximately 9 percent are mismatched both in formal qualifications and skills (McGowan & Andrews, 2015).

Wage losses for employees from overqualification are well documented. Employees who have a higher level of formal qualification than the level that is required for their job earn less than employees with the same level of qualifications in well-matched jobs. Although overqualified employees earn more money than employees who perform the same job and are adequately qualified for it, a part of the obtained qualification is not remunerated (Bauer, 2002; Boll & Leppin, 2013; Malcolm Brynin & Longhi, 2009; Hartog & Sattinger, 2013; Levels et al., 2014; Quintini, 2011; Szydlik, 1996). By introducing the idea of unobserved skills and their mismatch, Chevalier (2003) argues that overqualified employees should be separated into apparently and genuinely[2] overqualified. Apparently overqualified individuals have a wage loss of 5-10 percent, whereas genuine overqualification leads to a wage loss of 22-26 percent compared with adequate employment (see also Chevalier & Lindley, 2009; Green & Zhu, 2010). Other studies that focus on skills mismatch also show negative wage effects when skills and skill demands are not well matched (Allen et al., 2013; Allen & van der Velden, 2001; Bijlsma & van der Velden, 2015; Mavromaras, McGuinness, & Wooden, 2007). Differentiating between men and women, McGuinness and Sloane (2011) find a wage penalty that is caused by overqualification for both genders; however, in the case of greater skills than the job demands, they find negative effects only for men (compare also Mavromaras et al., 2007).

The theoretical basis for the negative wage effects that are due to formal overqualification and skills mismatch is provided by multiple theories. According to human capital theory (Becker, 1962; Mincer, 1974), wages are determined by employees' productivity, which is determined by skills that are developed through formal education and on-the-job training. Mismatches (and, thus, a market disequilibrium) can only be short-term phenomena because of adjustment processes that respond to any shocks that induce imbalances between the supply of and the demand for labor. Because employers want to completely exploit the skills of the employees who they need, a larger skill set results in higher wages that conform to the individual's marginal product, which is, in turn, assigned by accumulated human capital (McGuinness, 2006; Quintini, 2011). In contrast, the job competition model (Thurow, 1975) predicts that the only factors that influence wages are the characteristics of the job. The qualification level of employees is only important for the allocation of jobs. When their qualification level is higher, employees' assumed additional training costs are lower and their position is better in the hiring queue in the competition for jobs. According to this theory, there is no return to a qualification surplus because wages are fully determined by the required qualification level of a job. The assignment model, which is based on Sattinger (1993), represents a position that is in-between these two theories and emphasizes the importance of individual and job characteristics. Following this approach, mismatches and their negative impacts on wages can be ascribed to a mismatch in competent employees and complex jobs

[2] The author defines *apparent overqualification* as the case in which an individual is formally mismatched but satisfied with the match of his/her qualifications and work and *genuine overqualification* as the case in which an individual is formally mismatched and dissatisfied with the match between his/her qualifications and work (Chevalier, 2003).

and is instead perceived as persistent (Allen & van der Velden, 2001; Büchel, 1998; Hartog & Oosterbeek, 1988; McGuinness, 2006; Quintini, 2011).

Although these theories all predict wage penalties for employees who are formally overqualified or who suffer from skills mismatch, the magnitude of wage effects differs greatly among studies. One reason for this difference is that the approaches to measure formal overqualification and skills mismatch are manifold (Verhaest & Omey, 2006). The attempts to measure formal overqualification can mainly be separated into subjective (Büchel, 1998, 2001; Hartog, 2000; Hartog & Oosterbeek, 1988) and objective measurements (for examlple Malcom Brynin, 2002; Van der Velden & Van Smoorenburg, 1997; Verhaest & Omey, 2010). Likewise, skills mismatch can be measured either subjectively (e.g. Allen & van der Velden, 2001; Green & Zhu, 2010; Mavromaras et al., 2007; McGuinness & Sloane, 2011; Rohrbach-Schmidt & Tiemann, 2016) or objectively. Most previous studies that attempt to measure skills mismatch objectively approximate an individual's set of skills with a test-based measurement of numeracy or literacy skills (Desjardins & Rubenson, 2011; Flisi et al., 2017; Levels et al., 2014; McGowan & Andrews, 2015; Pellizzari & Fichen, 2013). Skill demand is also approximated by using various approaches. Bijlsma and van der Velden (2015) identify the following three approaches that have been used in the literature, which all target skill demands: (i) respondents' self-assessment by asking about the required level of certain skills in their job; (ii) the "realized matches approach" in which the requirement level of a job is measured through the average or median skill level per occupation; and (iii) the "job requirement approach" that utilizes the use of skills in a respondent's job as a proxy for the required skills of this job. Additionally, these scholars introduce (iv) the "skill effort approach" that employs the product of skill use and skill proficiency as a proxy for the skill requirements of a job.

The pluralism of approaches to assess formal overqualification and skills mismatch and their impacts on wages originates from constant improvements in the possibilities to measure the supply of and demand for formal qualifications, as well as skills and their mismatch. We argue that more direct measures are clearly preferable, because all information that is based on self-reporting may be biased because of conscious or unconscious misjudgments (for example, Hartog, 2000). However, all approaches to directly measure mismatches have thus far suffered from a common drawback: the supply of and demand for skills has only been measured at a general level (for example, literacy and numeracy skills). We argue that mismatches should mostly originate from a disparity in supplied and demanded skills at an occupational level. We also argue that an analysis of the mismatch of occupational skills and skill demands yields new and more precise insights into the mechanisms that are behind overqualification and its impact on wages.

3. The Role of Occupational Skills and Skill Demands

Previous studies have shown that the measures of formal overqualification and skills mismatch do not necessarily capture the same phenomenon but target two aspects of labor market mismatches that each contribute to lower wages. The majority of these studies that refer to skills mismatch implicitly assume that skills are homogenous and can be completely transferred from one job to another and across occupations within one qualification level. These studies thus assume a mismatch of general skills that are usually assessed with numeracy and literacy scores.

We argue that such skill measurements cannot sufficiently capture the complex match between the specific skill sets of employees and the skill requirements of their job. On the contrary, we assume that these general cognitive skills are basically required in any qualified job. Instead, it is occupation-specific human capital that is acquired through vocational or academic education and on-the-job training that makes an employee productive in a job and that is therefore relevant to set wages (for task-specific skills, see Acemoglu & Autor, 2011; Gathmann & Schönberg, 2010; in general, see Poletaev & Robinson, 2008). Mismatches should originate from a disparity in supplied and demanded skills at the occupational level, because occupations represent indivisible bundles of tasks (Autor & Handel, 2013) that are performed by employees with different skill sets. We argue that the similarity of the core requirements between the trained and the current occupation represents a more precise way to measure whether a person's set of skills matches the skill demands of their job, which has a great impact on wages.

Theoretically, this view is supported by Becker's (1962) distinction between general skills and the skills that are specific to a certain firm and/or occupation. Moreover, the extensive analyses of Kambourov and Manovskii (2008, 2009) show that human capital is mostly specific to industry and occupation. In this regard, some studies argue that it is important to consider that the transferability of human capital/skills depends on the similarity of occupations (Chevalier, 2003; Clark & Fahr, 2001; Gathmann & Schönberg, 2010; Nawakitphaitoon & Ormiston, 2016). Accordingly, Hall (2011) accentuates the importance of the specificity of occupations and the potential for transferring skills between occupations. Her analysis shows that two thirds of the human capital that is acquired in vocational training is purely occupation-specific and is lost in the event of an occupational change. One third of this human capital is more general and, therefore, transferable. The proportion of occupational specificity varies with the training occupation: when the specificity is higher, the consequences of an occupational change are more negative (Hall, 2011).

We assume that formal overqualification and the mismatch of occupational skills and skill demands represent two different aspects of the mismatch between employees and jobs. We also argue that the mismatch of occupational skills can partly explain the negative effects of formal overqualification. In the cases of a low demand for labor in an employee's trained occupation and restrictions on spatial mobility, employees will most likely take on other occupations (Reichelt & Abraham, 2017). When employees can be made to use fewer occupational skills, these employees will more likely have to accept jobs with lower formal requirements. We assume this mechanism to be particularly present for employees with vocational training. Within the vocational training system in Germany, access to most occupations is highly regulated (Allmendinger, 1989; Blossfeld & Mayer, 1988; DiPrete, De Graaf, Luijkx, Tahlin, & Blossfeld, 1997). For academics, crossing occupational borders may involve a partial transfer of occupational skills because of the often-unregulated nature of academic occupations. Moreover, academic training should involve more general human capital that is applicable to a wider range of occupations.

Based on these considerations, we arrive at four hypotheses. Based on the job competition and the assignment models, we assume that employees will be paid less for jobs with lower formal requirements because of lower training costs and higher competitiveness. Consistent with the previous literature, we thus first predict that

Compared with being employed at an adequate level, formal overqualification is associated with wage penalties (hypothesis 1).

Because occupational experience and occupation-specific human capital are the main determinants of wages (Kambourov & Manovskii, 2008, 2009; Shaw, 1984, 1987), we argue that a mismatch between obtained and required occupation-specific skills also negatively affects wages.

When the similarity between acquired occupational skills and skill demands is lower, the wage penalty is higher (hypothesis 2).

We assume that formal overqualification is partially a result of employees who must work in occupations with skill demands other than the demands that they were trained for. We thus predict that

The similarity of acquired occupational skills and skill demands partially explains the negative wage effect of overqualification (hypothesis 3).

Finally, we assume that vocational training is associated with more specific occupational skills than academic training. Employees with vocational training will thus more likely have to work in formally overqualified jobs in the case of a mismatch of occupational skills.

For employees with vocational (compared with academic) training, the similarity of acquired occupational skills and skill demands better explains the negative wage effect of formal overqualification (hypothesis 4).

Although previous research has noted that formal overqualification is generally associated with lower wages, examining these hypotheses will shed light on the mechanisms of the negative effects. We aim to disentangle the effects of the similarity of occupational skills and formal overqualification and to show that both explanations are prevalent and closely tied.

4. Research Design

4.1 Data and Sample Restrictions

Our empirical analysis draws on two linked datasets (NEPS-SC6-ADIAB), namely, the survey of adults by the National Educational Panel (NEPS, starting Cohort 6)[3] (Blossfeld, Roßbach, & von Maurice, 2011) and the administrative data of the German Federal Employment Agency (Bundesagentur für Arbeit). The survey (retrospectively) collects the full range of education and employment histories of adults during their working life and is enriched by prior life course information (for example, regional mobility, partnerships, children, and other circumstances that influence the decisions concerning educational and labor market activities). The administrative data comprise employment-related information on all employees in Germany who are subject to mandatory social insurance contributions. The linked dataset thus comprises the employment histories for all employees who are subject to

3 The first wave, which includes the survey period from 2009-2010, is linked to the administrative dataset.

social security contributions and who participated in the NEPS survey and consented to link their administrative data.

The analysis is restricted to the period from January 1992-2010. The trainees and individuals who perform military or civilian services and self-employed individuals are excluded from the study population. We further restrict our sample to the employment episodes that begin after the highest qualification degree is obtained. We thus exclude temporary overqualification that results from delayed changes to adequate employment after employees obtained a higher qualification degree (for example, through evening school). Moreover, we only select full-time employees who are over 18 years old because the administrative data lack information on the hours that were worked.

4.2 Main Variables

To explain the effects of overqualification on wages, we use the individual deflated net daily wage from the administrative data as the dependent variable. For wages that are right-censored at the social security contribution limit, we impute the information with an interval regression that uses schooling, qualification, age, gender, region, industry, occupational codes and firm size variables. To account for the right-skewed distribution of the wages, we transfer the values with a natural logarithm (for a more thorough explanation, see Reichelt, 2015).

Our central explanatory variables are formal overqualification and similarity of occupational skills. To define whether an employee is formally overqualified, we apply an objective measurement. By using the data that include the new German Classification of Occupations 2010 (KldB 2010), we can use the attribute "requirement level of occupations" for our objective measurement. The KldB 2010 is a five-digit classification that is based on two dimensions, namely, occupational expertise that is coded within the first four digits and the requirement level that is coded at the fifth digit. The latter digit comprises four requirement levels to distinguish the degree of complexity of an occupation. The degree of complexity quantifies the skills and knowledge that are usually required to practice an occupation. The degree of complexity is guided by the level of formal qualifications that is needed to acquire these skills and knowledge. For skilled activities (requirement level 2), at least two years of vocational training are required; for highly complex activities (requirement level 4), employees must possess a completed university degree of at least four years (for details, see Paulus & Matthes, 2013). However, the actual formal qualifications of a person who practices a job in a particular position is irrelevant to the assignment; the employee can be adequately qualified, overqualified or underqualified (see Figure 1). We use this objective operationalization because it reduces uncertainties that could be caused by the different technical, theoretical and methodical backgrounds of subjective measurements. In our approach, the measurement of overqualification cannot be influenced by (mis)judgements concerning the respondents themselves.[4] We create a dichotomous indicator for overqualification with the value of one if the formal qualification of an individual exceeds the requirement level of the occupational position and zero if the individual is adequately qualified or underqualified for the position.[5]

4 For detailed discussions on the advantages and disadvantages of several measurements of overqualification, see Büchel (2001), Hartog (2000), Leuven and Oosterbeek (2011) and Verhaest and Omey (2010).

5 See the Robustness checks section for the results of other operationalization.

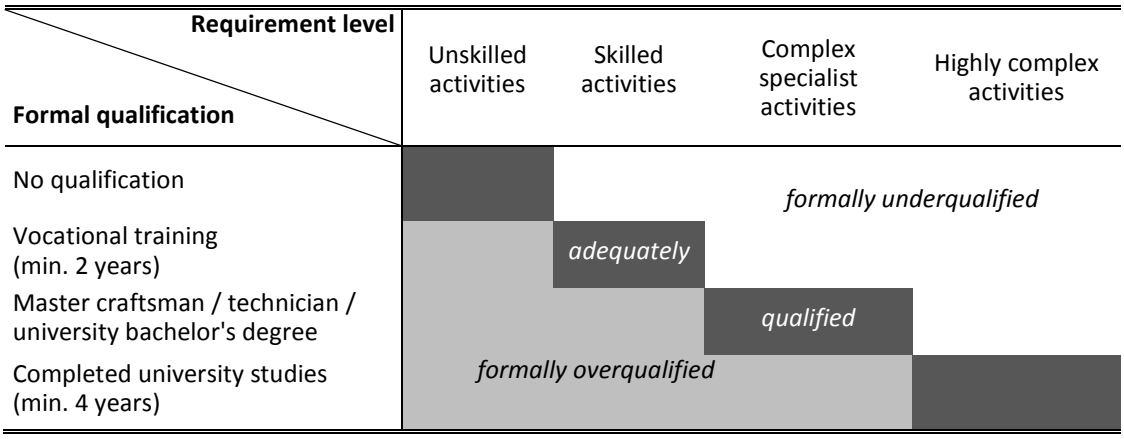

Figure 1: Requirement levels and qualification adequacy

Our second central explanatory variable is the measurement of the similarity between trained occupational skills and the skill requirements of the current occupation. Each occupation consists of a bundle of tasks that require certain skills and competencies. If some of these tasks are shared in two occupations, these two occupations are similar to some extent in terms of their required skills. The degree of similarity increases with the number of identical tasks in both occupations. Accordingly, the skills transferability in the event of an occupation change is higher with a higher degree of similarity. To measure the degree of similarity between two occupations, we use an aggregated version of the indicator that was developed by Matthes and Vicari (2017). We employ this indicator at the aggregation level of occupational groups (three-digit code) including the attribute "requirement level" (fifth digit) of the KldB 2010.

The data for the indicator are derived from BERUFENET, a free online information portal for all occupations in Germany. BERUFENET is provided by the German Federal Employment Agency and is mainly used for career guidance and job placement. The administrative expert database is constantly updated and quite similar to the U.S. American O*Net.[6] Currently, BERUFENET describes approximately 3,900 occupations (as eight-digit codes, which is the most detailed level of occupations) and provides a rich set of occupational information, such as the required qualifications, certificates and licenses, requirements in an occupational activity, equipment used, working conditions, potential specializations and further training (Dengler, Stops, & Vicari, 2016).

The similarity indicator is based on the matrix of requirements in an occupational activity for all described occupations. For the indicator, only core requirements are used. Core requirements "are requirements which are mandatory to work in the occupation, because they are essential […] to perform the corresponding occupation" (Dengler, Matthes, & Paulus, 2014, p. 12). For example, the core requirements for a painter may include painting, varnishing, wallpapering, facade maintenance and renovation, and surface treatment. A floor tiler may lay tiles and slabs, place mosaics, and treat surfaces. An office assistant may organize and manage office processes, complete correspondence, operate the telephone service, file

6 For more information, please visit the BERUFENET homepage: http://berufenet.arbeitsagentur.de.

documents, and provide information.[7] These examples show the shared core requirements (or required skills) of painters and floor tilers but no shared core requirement between these two jobs and the office assistant. For our analyses, we use the indicator similarity of occupational skills with the three categories of no similarity, partial similarity, and complete similarity in the required occupation-specific skills between two occupations. Although in principle the indicator allows for a more nuanced view of the similarity, our analytical design and our sample size suggest the use of this aggregated version.

4.3 Control Variables

To control for additional wage-influencing variables, we integrate many additional control variables into the models. To control for both age effects and the effects of individual labor market experience, we include variables for age (and age squared) and individual professional experience (adjusted for any career breaks). The duration between jobs, which is measured in months, controls for a non-employment break. A longer break would most likely affect wages negatively because of human capital depreciation. We also control for training activities during the career path. This dichotomous variable receives a value of one if any type of training activities, such as courses at an adult education center or on-the-job-training, occurred and is zero otherwise.

Partnership and cohabitation are important factors when decisions concerning labor market participation are made (for mobility decisions compare, for example Abraham & Schönholzer, 2009; Bielby, 1992). It is assumed that particularly in the case of marriage, the partner influences labor market-relevant decisions. Therefore, we include marital or cohabitation status with the conditions "married/registered partnership, living together", "unmarried, living together" and "in partnership but not living together or single". Furthermore, children under the age of 18 years who live in the household is an important and decision-relevant factor, which we control for. Additionally, we control for the federal state of residence, because the portion of overqualified employees varies across federal states (for example, in East Germany, overqualification is a larger problem) (Reichelt & Vicari, 2014). For a complete list of the control variables, see the full model in the Appendix.

4.4 Empirical Strategy

The aim of this paper is first, to assess the effects of formal overqualification on wages, second, to analyze the effects of a mismatch of occupational skills on wages and third, to analyze whether the mismatch of occupational skills can partly explain the wage effects of formal overqualification.

We first calculate a pooled linear regression (pOLS) of the logarithm of the daily wage on formal overqualification and the above-named control variables to obtain a general picture of the effects of formal overqualification on individual wages. In the next step, we use the longitudinal character of our data and calculate nested individual fixed-effects regressions as follows:

7 There are between two and 20 core requirements or 7.4 core requirements on average (Dengler et al., 2016) that describe each occupation. However, there is no evidence of a systematic difference in the description among different occupation types, such as occupations in the producing industry compared with occupations in the service sector.

$$\ln(y)_{it} = \beta_0 + \beta_1 overquali_{it} + \beta_k similarity_{kit} + \beta_l X_{l,it} + \alpha_i + \epsilon_{it},$$

where $\ln(y)_{it}$ is the logarithm of the daily wage of individual i at time t, $overquali_{it}$ is a dummy that indicates whether the individual qualifications exceed the qualifications that are necessary to conduct the job, $similarity_{kit}$ indicates three dummies for the degree of similarity between occupations, which enter the equation in the final model, and $X_{l,it}$ represents all l control variables. Furthermore, α_i is the person fixed effects that control for all time-invariant characteristics, and ϵ_{it} is the individual residual at every point in time t. The control variables incorporate age in a single and a squared term, which models general wage growth over the life course. The effects of formal overqualification thus depict the average expected wage difference when changing from overqualification to non-overqualification or vice versa. Because we suspect serial autocorrelation in residuals over time, we utilize Huber-White robust standard errors (Cameron & Trivedi, 2010). We complement our analyses by calculating separate models for employees with vocational and academic training, which allows us to evaluate whether formal overqualification and the mismatch of occupational skills have different effects depending on the type of training that is received.

By employing fixed-effects regressions, we can provide a dynamic perspective and measure the effects of formal overqualification and a mismatch of occupational skills, which is the net of time-constant, unobserved individual heterogeneity. Previous studies have mostly used cross-sectional designs, but we can identify the effects of overqualification on wages through job changes and control for the effects that are likely to simultaneously affect wages and the probability of being overqualified, such as individual productivity. Although the model allows for a more precise analysis of the effects of overqualification, we cannot preclude the time-varying effects from having an impact on both wages and the probability of being overqualified. If previously acquired skills are made redundant (e.g., because of technological change), individuals' productivity may decline, wages may decrease and the probability of overqualification may rise. We thus abstain from claiming that we identify causal effects; however, we offer a more precise measure of how and why overqualification is associated with lower wages.

5. Results

5.1 Descriptive Results

To assess the magnitude of overqualification and its impact on wages, we first examine the distributions of these quantities in the empirical sample. After restricting the sample, we are left with 332,515 employment observations, and in approximately 18 percent of these observations, the employees are formally overqualified. By focusing on employment episodes instead of monthly observations, we observe that approximately 20 percent of all episodes in our sample (N=6,670) are employment relations with a lower requirement level than the formal qualification level of the employee. Likewise, we observe that approximately 26 percent of all individuals in our sample (N=3,429) experience at least one episode of overqualified employment in our data (see Table 1). The higher share of persons compared with employment episodes indicates that overqualification is a dynamic process and that employees change into and out of overqualification.

Table 1: Formal Overqualification

		Non-overqualified	Overqualified	Total
Observations	N	271,890	60,625	332,515
	Percent	81.8	18.2	100
Employment episodes	N	5,317	1,353	6,670
	Percent	79.7	20.3	100
Persons with at least one episode of […] employment	N	2,932	888	3,429
	Percent	85.5	25.9	100*

Source: Own computations based on the NEPS-ADIAB. Sample restrictions apply. Years 1992-2010. Percentages sum to over 100 because most persons who experience an employment episode of formal overqualification also experience an episode of non-overqualification.*

By focusing on the mismatch of occupational skills, we observe that approximately 11 percent of our monthly observations are employment relations without any similarity of occupation-specific skills between the training and the current occupation (see Table 2). Moreover, 55 percent of the observations share parts of the core requirements and skills, and 33 percent have complete similarity, most likely because employees are working in their original training occupation. When examining employment episodes, we observe that in the majority of cases (88 percent) employees have working arrangements in which at least the partially required and acquired skills are compatible. However, we assume that in particular, the 12 percent of employment episodes in which no occupational skills are similar suffer from more severe pay cuts. In addition, we observe that approximately 17 percent of all employees have at least one episode in which no core occupational skills that were acquired during the training period are demanded. Such mismatches thus do not seem to be uncommon.

We do not observe that specific combinations of the training and current occupation are prevalent when no occupational skills are similar. However, the most common target occupations are “Office clerks and secretaries” and “Occupations in warehousing and logistics, in postal and other delivery services, and in cargo handling”.[8]

8 Measured as occupational groups (a three-digit code) of the German Classification of Occupations 2010 (KldB 2010).

Table 2: Similarity of Occupation-Specific Skills Between the Training and Current Occupation

		No	Partial	Complete	Total
Observations	N	37,929	183,602	110,984	332,515
	Percent	11.4	55.2	33.4	100
Employment episodes	N	826	3,688	2,156	6,670
	Percent	12.4	55.3	32.3	100
Persons with at least one episode of […] similarity	N	577	2,106	1,443	3,429
	Percent	16.8	61.4	42.1	100*

*Source: Own computations based on the NEPS-ADIAB. Sample restrictions apply. Years 1992-2010. * Percentages sum to over 100 because most persons experience more than one employment episode.*

Comparing the wages of overqualified and non-overqualified employees, we observe that for every level of formal qualification, overqualified employment is associated with lower wages (see Table 3). At least descriptively, we do not observe that there is a clear wage surplus for a higher level of similarity of occupational skills. However, employees with no similarity between their obtained and required occupational skills on average earn less (96.6 EUR) than employees with partial similarity (119.5 EUR) and complete similarity (108.5 EUR).

Table 3: Average Daily Wages (in Euros)

	Formal qualification of employees			
	None	**Vocational training**	**Master craftsman/ technician/ bachelor**	**University (of applied sciences) degree**
Non-overqualified	*	91.6	139.5	166.9
Overqualified	-	68.0	101.0	124.3

*Source: Own computations based on the NEPS-ADIAB. Sample restrictions apply. Years 1992-2010. * No observations because all employees without a training occupation are excluded.*

5.2 Multivariate Results

The descriptive results show that overqualified employees on average have lower wages than employees with the same formal qualifications in adequate positions. Do these results hold when analyzing and controlling for the differences in occupations, skills and individual heterogeneity and can the similarity of occupational skills partly explain the negative wage effect? To answer these questions, we first calculate a pooled OLS model (see model 1 in Table 4). This model confirms our descriptive results and shows that formal overqualification is generally associated with true wage losses of approximately 11 percent (EXP(-0.113)-1), even when controlling for individual differences such as age or professional experience.

Table 4: Effects on the log individual deflated net daily wage

	Model 1 (pOLS)	**Model 2 (FE)**	**Model 3 (FE)**
Formal overqualification	-0.113 ***	-0.052 ***	-0.044 ***
	(0.019)	(0.015)	(0.016)
Similarity of skills (ref: no)			
Partial			0.043 **
			(0.020)
Complete			0.060 **
			(0.025)
Controls	yes	yes	yes
Constant	4.660 ***	4.385 ***	4.320 ***
	(0.050)	(0.163)	(0.162)
Adj. R-squared	0.305	0.185	0.186
Observations		332,515	
Number of persons		3,429	

Note: Model 1 presents a pooled OLS regression, and models 2 and 3 present fixed-effects regressions. All models control for age, age², professional experience, duration between job changes, training activities, cohabitation status, children under 18 years of age in the household, and the federal state of residence. (See the Appendix for a full model).
Source: Own computations based on the NEPS-ADIAB. Years 1992-2010.
*Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.*

When introducing a person-fixed effect in model 2 (in Table 4), we observe a reduced size of the wage effect. However, formal overqualification is still associated with lower wages. Specifically, the results now show that changing from adequate or underqualified employment to a job at a lower requirement level is associated with 5.1 percent lower wages on average (EXP(-0.052)-1). This result is consistent with common findings and can primarily be explained by the wage differentials between different requirement levels, which supports our first hypothesis. However, the reduction of the effect shows that the lower wages of formally overqualified persons are largely due to the unobserved differences among persons, such as differences in productivity or in the choice of occupations.

In model 3 in Table 4, we add our measurement for the similarity of required occupation-specific skills between the training occupation and the current occupation. The similarity between the training and the current occupation partly explains the negative effect of formal overqualification. Being employed in an occupation with some similarity in skills is associated with higher wages. If the job requires the same occupation-specific skills that are acquired in training, the employment relation is associated with 6.2 percent higher wages than being employed in a job with no similarity in the required skills. In general, we observe a wage premium for a higher similarity of occupational skills. The skills that were acquired during vocational or academic training are thus rewarded when they can be fully exploited in the

current job. While parts of the effect of formal overqualification are explained, our results also show that employees who work in a job with a lower requirement level also often work in an occupation where they can exploit only part of the occupation-specific skills that were acquired in their vocational or academic training. In general, these effects support our second hypothesis.

Including both effects in the model also shows that changing to a job with a lower requirement level than an individual's formal qualifications is only associated with a negative wage effect when no occupation-specific skills are matched. If at least some of the acquired and required occupational skills are similar, the effects of formal overqualification and similarity of occupational skills cancel one another out. We ascribe this finding to a certain degree of selectivity in job changes. Changing to a job with a lower requirement level most likely occurs because of a lack of other appropriate options. As a result, employees accept lower wages than the wages of their previous job.

We cannot exclude the possibility that the remaining effects of formal overqualification are due to part of the occupational skill mismatch that we did not capture. Nevertheless, we conclude that at least two mechanisms are at work, namely, a lack of similarity of occupation-specific skills between the training and the current occupation and remuneration at a generally lower requirement level. To test these two mechanisms in more detail, we analyze the effects of formal overqualification and the mismatch of occupational skills separately for employees with vocational and university degrees. We assume that the portion of the similarity of occupational skills is particularly prevalent for employees with vocational degrees.

5.3 Vocational and Academic Overqualification: Different Reasons for Wage Penalties

The German labor market and its emphasis on the vocational training system impose barriers to occupational mobility for at least part of the workforce (Allmendinger, 1989; Blossfeld & Mayer, 1988; Müller & Shavit, 1998). These barriers may be protective for employed workers and may guarantee a structured entry path into occupations (Haupt, 2016). However, we also assume that employees with vocational training who do not find jobs in their trained occupation are more likely to be employed in jobs that have no similarity in the required occupation-specific skills. As a result, the similarity of occupational skills should have a greater impact on the wage penalties of overqualified employees with vocational qualifications, particularly because we have shown that having no similarity in occupational skills has a severe negative impact on wages.

Figure 2 shows the amount of the shared occupation-specific skills between the training and current occupation separately for employees with vocational or academic training. Comparing both types of employees, our assumption seems to hold. Employees with vocational training are more often employed in a job with skills that are entirely dissimilar to the training occupation (12.9 percent compared with 8.0 percent for employees with academic training). Employees with academic training are more often employed in jobs with at least a partial overlap in occupational skill requirements.

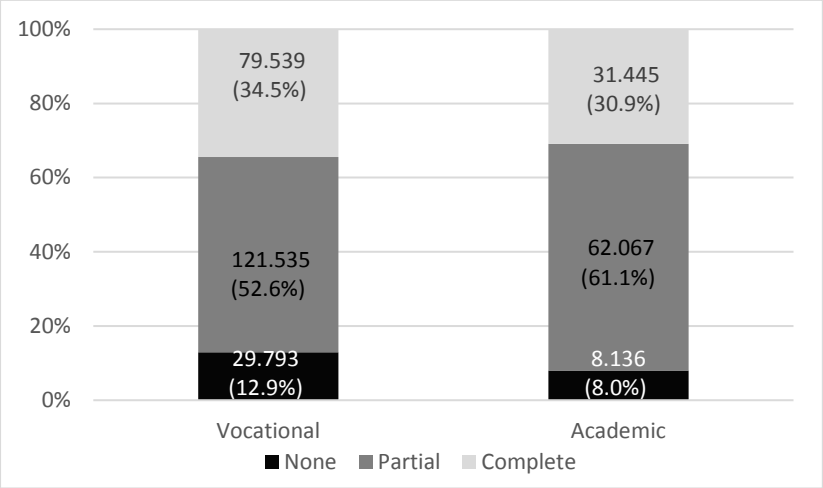

Figure 2: Similarity of occupation-specific skills in overqualified employment for employees with vocational and academic training. Source: Own computations based on the NEPS-ADIAB. Sample restrictions apply. Years 1992-2010. N=Monthly observations.

To analyze whether the differences in the type of job change contribute to the differential effects of the overqualification between employees with vocational and academic training, we calculate separate fixed-effects regressions for the two groups. Table 5 shows the fixed-effects regression without (models 4 and 6) and with the level of similarity (models 5 and 7). For both groups, we generally find a negative effect of formal overqualification in the models; however, the effect is nearly twice as large for employees with academic training (-.066 compared with -.032). This result primarily reflects that the scope of formal overqualification is higher for employees with academic training who simply have more to lose. The results also show that the negative effects of overqualification are largely driven by employees with academic training.

The similarity of occupation-specific skills in model 5 shows comparable results to our previously calculated regression. However, for academics, we cannot identify significant effects. The reason may be heterogeneous effects that are due to the greater share of general human capital that is required in academic occupations.

Interestingly, the effect of formal overqualification becomes insignificant for employees with vocational training when controlling for the similarity of occupation-specific skills. We thus conclude that the large portion of employees who are employed in jobs with no skill similarity explains a large part of the negative wage effect for overqualified employees with vocational training. We can no longer identify a singular effect of formal overqualification, when we control for the similarity of occupational skills. Employees with academic degrees, however, more often seem to be employed in jobs with at least a partial overlap of occupation-specific skills. The already greater negative wage effect of formal overqualification remains even after controlling for the similarity of skills. We thus conclude that higher standardization and stricter boundaries for occupational mobility in vocational jobs lead to a greater share of employees who change to helper jobs (jobs with no specific occupational requirements) with no overlap in skill requirements.

Table 5: Effects on the Log Individual Deflated Net Daily Wage for Employees with Vocational or Academic Training

	Vocational training		Academic training	
	Model 4 (FE)	**Model 5 (FE)**	**Model 6 (FE)**	**Model 7 (FE)**
Formal overqualification	-0.032 *	-0.020	-0.066 ***	-0.067 ***
	(0.019)	(0.020)	(0.021)	(0.023)
Similarity of skills (ref: none)				
Partial		0.042 **		0.073
		(0.020)		(0.069)
Complete		0.059 **		0.049
		(0.023)		(0.085)
Controls	yes	yes	yes	yes
Constant	4.427 ***	4.356 ***	4.830 ***	4.777 ***
	(0.115)	(0.120)	(0.064)	(0.108)
Adj. R-squared	0.142	0.144	0.308	0.311
Observations	230,867		101,648	
Number of persons	2,384		1,045	

Note: All models present separate fixed-effects regressions and control for age, age², professional experience, duration between job changes, training activities, cohabitation status, children under 18 years of age in the household, and the federal state of residence.
Source: Own computations based on the NEPS-ADIAB. Years 1992-2010.
*Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.*

5.4 Robustness Checks

To check the robustness of our results, we conducted several analyses that were based on different sample definitions or different operationalization.[9] We recalculated our analyses by using many different definitions for our main variables. Our analyses are based on a broad distinction between no, partial and complete similarity of occupational skills. As a robustness check, we used a more fine-grained version of the similarity of occupational skills; however, we did not find substantial differences among the effects for different amounts of partial similarity. In addition, the reduction of the formal overqualification effect remained the same. Moreover, we recalculated the similarity of occupational skills based on a comparison between the current and the previous occupation rather than the current and the training occupation. The similarity between two subsequent occupations did not show any significant effects, which emphasizes that indeed occupational skills that are acquired during training periods are better capturing the skills that are provided by an employee. The skill demands of a previous job may or may not reflect the occupational skills that an employee has. We also

9 All results are available upon request.

recalculated all analyses excluding imputed wages, which did not substantially alter our results.

Moreover, we included three digit-coded occupational dummies to check for selection into specific lower paid occupations and overqualification. Although our fixed-effects regressions remained the same, the effect of formal overqualification in our pooled model became substantially smaller. The reduction shows that much of the unobserved heterogeneity that we are capturing with our fixed-effects is translated to different occupations. Thus, a large portion of the negative wage effect that is due to formal overqualification can be ascribed to lower paying occupations that also have a higher likelihood of employees who work below their formal qualifications.

We also assessed how robust our analyses are concerning the sample definition. Our analyses define underqualified and adequately employed individuals as the reference group. As a robustness check, we recalculated all models excluding underqualified individuals. Overall, the results point in the same direction. However, the effect of formal overqualification became smaller and thus insignificant for employees with vocational training. A closer examination reveals that approximately 20 percent of all employees with vocational training are underqualified, which represents usual career advancement over the life course. Excluding this supposedly highly productive group results in overall lower wages for employees with vocational training.

6. Summary and Discussion

Previous studies have documented the wage penalties for employees in overqualified employment. Such wage penalties are problematic for individuals and society and often reflect work arrangements that are not an ideal match. On a larger scale, these wage penalties reflect unexploited potential and mismatches in occupational labor markets. This study aims to ascertain which mechanisms can explain these wage penalties. We argue that mismatches of occupation-specific skills are an important contributor to lower wages, which should also partly explain the effects that are due to formal overqualification. We thus investigate whether wage penalties are caused solely by a mismatch of acquired and required formal degrees or partly by a mismatch of the occupational skills that are acquired through vocational or academic training and the skills that are required in current jobs. Furthermore, we examine whether these explanations differ depending on the vocational or academic degree of an employee.

By using the NEPS survey data, which is linked to the administrative data of the German Federal Employment Agency, we can test both explanations simultaneously and in an objective way by using the information on required formal degrees and occupation-specific skills and on supplied formal degrees and trained skills. By using pooled regressions, we first find that formal overqualification is associated with severe wage deductions. Second, by using a fixed-effects design, we also find that individual heterogeneity explains approximately half of the effect; however, formal overqualification is still associated with approximately 5 percent lower wages. Third, we find that a lack of similarity in the acquired and required occupational skills partly explains the remaining wage loss. Although we cannot exclude the possibility that our measure of skill similarity does not capture all types of skills that constitute occupation-specific human capital, we still conclude that both explanations, formal

overqualification and a mismatch of occupational skills, contribute to wage losses and that a mismatch of occupational skills explains part of the effects of formal overqualification. The two explanations are tightly linked, and employees who are formally overqualified also often work in occupations that they are not trained for.

We also find that wage penalties for overqualified workers with vocational training can be explained by a mismatch of occupational skills. In contrast, for employees with a university degree, the similarity of occupational skills does not explain the negative effects of formal overqualification. These findings reflect that employees with vocational training more often work in jobs that require a completely different set of skills. We thus conclude that higher standardization and stricter boundaries between occupations in the vocational system, as well as more specific occupational training, lead to a greater share of employees who must work in jobs with lower and different skill requirements.

Although we are confident that our results emphasize the importance of occupational skills, our study has several limitations. First, our measurement of the mismatch of occupational skills can only partly capture the true set of required and acquired skills. We can thus show that the extent of the similarity of occupational skills contributes to wage losses and partly explains the wage penalties that are due to formal overqualification. However, we cannot show the true extent to which the mismatch of occupational skills explains these effects. Second, self-selection into certain occupations or career tracks may bias our results (i.e., if some employees have a higher probability of being overqualified and receiving lower wages due to an unobserved lack of productivity).

Nevertheless, this study is the first to measure the effects of the mismatch of occupational skills and how this mismatch relates to formal overqualification. We thus reveal a new mechanism concerning how formal overqualification contributes to wage penalties, and we also show that both explanations contribute to lower wages. To the best of our knowledge, we are also the first to show a wage effect of the objectively measured formal overqualification net of individual heterogeneity by using longitudinal data and employing fixed-effects designs. We suggest that future studies should differentiate between formal overqualification and a mismatch of occupational skills and further investigate their interdependency when analyzing why employees experience drawbacks that are due to inadequate employment.

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Appendix

Table A1: Effects on the log individual deflated net daily wage (full model)

	Model 1 (pOLS)		Model 2 (FE)		Model 3 (FE)	
Formal overqualification	-0.113	***	-0.052	***	-0.044	***
	(0.019)		(0.015)		(0.016)	
Similarity of skills *(ref: none)*						
Partial					0.043	**
					(0.020)	
Complete					0.060	**
					(0.025)	
Duration between job changes	0.000		-0.000		-0.000	
	(0.001)		(0.001)		(0.001)	
Age	0.028	***	0.011	***	0.012	***
	(0.002)		(0.001)		(0.001)	
Age^2	-0.001	***	-0.000	***	-0.000	***
	(0.000)		(0.000)		(0.000)	
Labor market experience (ref: 1-36 months)						
37-72 months	0.013		0.066	***	0.067	***
	(0.012)		(0.009)		(0.009)	
73-108 months	-0.014		0.106	***	0.107	***
	(0.018)		(0.015)		(0.015)	
109-204 months	-0.071	***	0.136	***	0.137	***
	(0.026)		(0.018)		(0.018)	
205-300 months	-0.163	***	0.160	***	0.161	***
	(0.036)		(0.019)		(0.019)	
more than 300 months	-0.251	***	0.171	***	0.171	***
	(0.045)		(0.021)		(0.021)	
Cohabitation Status *(ref: single)*						
married/registered partnership, living together	0.099	***	0.025	**	0.025	**
	(0.018)		(0.012)		(0.012)	
unmarried, living together	0.004		0.029		0.031	**
	(0.050)		(0.022)		(0.021)	
in a partnership but not living together	-0.057		0.016		0.017	
	(0.035)		(0.020)		(0.020)	
Children under 18 years of age in the household	-0.038	**	-0.023	***	-0.023	***
	(0.017)		(0.007)		(0.007)	
Training activities	0.003		0.000		0.000	
	(0.010)		(0.006)		(0.006)	
Further course and workshop attendance	0.178	***	0.022	**	0.023	**
	(0.015)		(0.011)		(0.011)	
Constant	4.660	***	4.385	***	4.320	***
	(0.050)		(0.163)		(0.162)	
Adj. R-squared	0.305		0.185		0.186	
Observations			332,515			
Number of ID			3,429			

Note: Model 1 presents a pooled OLS regression, models 2 and 3 present fixed-effects regressions.
*Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.*
Source: Own computations based on the NEPS-ADIAB. Years 1992-2010.