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## Are immigrants overeducated in Germany? Determinants and wage effects of educational mismatch

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**Discussion Papers  
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**Are immigrants overeducated in Germany?  
Determinants and wage effects of educational  
mismatch**

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# ARE IMMIGRANTS OVEREDUCATED IN GERMANY? DETERMINANTS AND WAGE EFFECTS OF EDUCATIONAL MISMATCH

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This paper investigates determinants and wage effects of educational mismatch for both natives and immigrants in Germany. Using the GSOEP panel data from 1991 to 2013, I find that conditional on educational attainment immigrants face a higher incidence of overeducation compared to their native counterparts. Among immigrants German language skills as well as education and experience gained in Germany are negatively correlated with the risk of overeducation. Results from the wage regression indicate that required education is equally rewarded for natives and immigrants, whereas immigrants suffer from a higher penalty from overeducation, but face a lower penalty from undereducation.

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Keywords: educational mismatch, wages, immigrants

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# 1 Introduction

As in most industrialized countries, the average educational level of the native population in Germany has increased over the last years. In 2014, 47.6% of native individuals between 25 and 30 years old hold a higher secondary schooling degree compared to 34.6% of the age group 40 to 45 and only 26.1% of the age group 55 to 60 (Federal Bureau of Statistics 2015, p.39). According to Seibert and Wapler (2012), the same educational trend can be observed for immigrants as especially new entrants show higher qualifications than their counterparts already residing in Germany. The authors illustrate that except for individuals with Turkish origin, recent immigrants in fact show on average a higher share of tertiary education attainment compared to German natives.<sup>1</sup> As education is rising, economists started to investigate whether attained education matches the job requirements in the labor market (see e.g., Hartog 2000). In an overview study, Leuven and Oosterbeek (2011) point to the well documented international phenomenon that a substantial share of individuals is facing an educational job mismatch, particularly overeducation. The article reveals that on average a country counts 30.0% overeducated workers meaning that about one third of the work force holds education higher than required for the job. While the literature on the economics of overeducation mainly concentrates on the native population, evidence focusing on immigrants is sparse.

Migration to Germany has risen substantially over the last decade and since 2009 the gap between inflow and outflow has widened. Given 1.11 million immigrants arriving and 0.66 million immigrants leaving in 2013, Germany constitutes one of the major immigrants receiving countries in Europe (Federal Office for Migration and Refugees 2015b). In addition, due to declining birth rates and demographic change the German population is aging and shrinking (Federal Institute for Population Research 2013). Both developments combined result in an increase in the proportion of immigrants living in Germany.<sup>2</sup>

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<sup>1</sup> For immigrants migrated in 2008 and surveyed in 2009, the share of individuals with tertiary degree amounts to 8% for immigrants from Turkey and 27% to 54% for immigrants from remaining destinations. The comparable value for individuals without migration background is 12% (Seibert and Wapler 2012).

<sup>2</sup> In 2012, 19.1% of the German population are first or second generation immigrants with Turkey (17.7%), Poland (9.7%), and Russia (7.6%) as major origins (Federal Bureau of Statistics 2012).

Thus, focusing on natives as well as on immigrants when analysing overeducation is of high relevance, particularly in Germany.

As far as I am aware, this is the first study for Germany investigating incidence, determinants, and wage effects of educational mismatch with a special focus on immigrants. The contribution to the literature is threefold. First, the German case is of particular interest as in contrast to most international evidence, immigrants show lower average education than natives. Second, following the argumentation of for example Poot and Stillman (2010) and contrary to the majority of the existing evidence, I include required education in the econometric model when analysing determinants of overeducation. Third, to the best of my knowledge this is the first study which incorporates the extent of education and experience obtained in the host country in the analysis of immigrant overeducation.<sup>3</sup>

Using the German Socio-Economic Panel (GSOEP) data, I find that conditional on educational attainment immigrants face a higher incidence of overeducation compared to their native counterparts. Analyses regarding immigrants reveal that German language skills as well as education and experience gained in Germany are negatively correlated with the probability of overeducation. Moreover, required education is equally rewarded for natives and immigrants, whereas immigrants suffer from a higher penalty from overeducation, but face a lower penalty from undereducation.

This paper is organized as follows. The next section outlines economic theories used in the context of immigrant educational mismatch and presents existing evidence. Section 3 develops two empirical approaches to separately model determinants and wage effects of overeducation, followed by a description of the data and variables in Section 4. Section 5 introduces estimation results and Section 6 contains robustness tests. The paper closes with concluding remarks in the last section.

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<sup>3</sup> For Germany, Basilio et al. (2010) show that whether education and experience is gained in the home or the host country influences wage assimilation of immigrants. In this study, I analyse whether the extent of human capital gained in Germany correlates with educational job mismatch.

## 2 Theory and existing evidence

### 2.1 Theoretical considerations

From a theoretical point of view, economists use different concepts to explain the phenomenon of educational mismatch. The following section presents predominating theories that refer both to natives and immigrants, but emphasizes the latter group.

Imperfect information in the labor market constitutes one explanation for the incidence of educational mismatch (Groot and Van den Brink 2000). Both employer and potential employee lack information in the search and match process. As an example, during a job interview the employer does not get to know the complete skill profile of the applicant whereas the applicant is not fully informed about the future job tasks. Mismatch due to imperfect information is of temporary nature and concerns therefore especially job entrants. With increasing time and experience they will find a more suitable job match since essential information improves. In contrast to natives, immigrants lack information on the host country labor market to a larger extent, particularly shortly after migration and if the economic and cultural difference between home and host country is substantial. Thus, immigrant overeducation is initially very likely and should decrease with increasing time spent in the host country as work experience increases (see e.g., Piracha et al. 2013; Poot and Stillman 2010).

According to the theory of signaling by Spence (1973), educational mismatch arises within the signaling and screening process of the worker's education. During the hiring process, the employer perceives formal education (and work experience) as a signal of the worker's unobserved abilities and skills. In contrast to the theory of imperfect information, the signal of education assigns workers to firms irrespective of whether or not imperfect information exists. Shortly after the worker completed education, the extent of mismatch is expected to be zero. Regarding individuals with identical level of education, the employer may however promote more productive workers and demote less productive workers. Thus, the mismatch is expected to increase with time in the labor market since

information about the worker's productivity become more transparent. Regarding immigrants, foreign education may pose uncertainty to the employer. If risk aversion of the employer is assumed and applicants with identical characteristics but host country education exist, immigrants are likely to be overeducated shortly after migration since the signal of their education is not clear. The more able the employer is in evaluating the foreign education, the less the extent of overeducation will be. Mismatch can be reduced by gaining host country work experience, a signal the employer is more familiar with (Chiswick and Miller 2009; Poot and Stillman 2010).

Sicherman (1991) states that human capital does not only consist of formal education, but comprises further components such as work experience, on-the-job training, and abilities which are interchangeable. For example, an overeducated worker substitutes low work experience with high formal education while an undereducated worker substitutes extensive work experience with low formal education. Job entrants are expected to have a higher probability of being overeducated as their level of formal education compensates for the lack of work experience (Leuven and Oosterbeek 2011). Immigrant human capital such as education and work experience obtained abroad suffers from less than perfect transferability across countries. Transferability is even more restricted if language skills and knowledge about the host country labor market are less developed (Beckhusen et al. 2013). However, Chiswick and Miller (2009) claim that foreign formal education is transferable to a higher degree than foreign work experience. This means that formal education may compensate to a larger extent for non-valued work experience gained in the home country than vice versa. The theory expects immigrants to face a higher risk of overeducation compared to natives, especially shortly after arrival. A better match can be achieved by enhancing host country specific human capital such as new work experience, language skills, and knowledge about norms and values.

The theory of career mobility by Sicherman and Galor (1990) defines overeducation as a temporary phenomenon occurring only at the beginning of a worker's career. By taking up a first job requiring less education than obtained, the worker intends to further

invest in job-specific human capital and anticipates to climb up the occupational ladder. As immigrant home country specific human capital is less than perfect transferable, new arrivals are with high probability overeducated but aim to reduce the risk of mismatch by acquiring important host country specific human capital (Poot and Stillman 2010).

Economists use Becker's (1964) human capital theory and Thurow's (1975) job competition theory as two opposing approaches to relate educational mismatch to wages.

According to Becker's (1964) human capital theory, wages are determined by the level of the worker's human capital and not by the requirements of the job. Hence, colleagues doing the same job could earn different wages if attained education differ. The underutilization of the worker's skills, i.e. overeducation, is only in the short-run consistent with the theory as firms adjust their technology to the worker's human capital (McGuinness 2006). The human capital theory expects every year of education to have the same return to wages, regardless of whether or not the level of education is required for the job.

Regarding Thurow's (1975) job competition theory, wages are in contrast determined by the characteristics of the job and not by the worker's education. The theory assumes that job-specific skills are acquired through on-the-job trainings and not through formal education. Thus, firms predominantly hire workers with low estimated training costs. As a worker with higher education than other competitors may have lower estimated training costs, the job competition theory allows overeducation to exist (McGuinness 2006). However, the theory expects years of formal education above or below those required for the job to be not rewarded since wages are only determined by job requirements.

## **2.2 Hypotheses**

Based on the theoretical considerations I derive the following five hypotheses, which I test in Section 5. Three hypotheses (H1 to H3) refer to the determinants of overeducation, whereas two hypotheses (H4 and H5) focus on the relationship between educational mismatch and wages.

First, as supported by all theories presented in the first part, I formulate the hypothesis that immigrants face a higher risk of mismatch compared to natives (H1). Second, native mismatch is highest for job entrants but diminishes with time in the labor market according to the theories of imperfect information, human capital, and career mobility. Contrarily, the theory of signaling predicts no mismatch at the beginning of the worker's career, but increasing mismatch with time in the labor market for natives. To investigate which theoretical consideration is empirically supported, I test the hypothesis that mismatch decreases *ceteris paribus* with increasing work experience and tenure for natives (H2). Third, with focus on immigrants and as supported by all respective theories, I formulate the hypothesis that increasing investments into host country specific human capital such as education, work experience, and language skills lower *ceteris paribus* the probability of mismatch (H3). Fourth, according to the human capital theory I test the hypothesis that *ceteris paribus* the wage return to the years of education required for the job equals the wage return to those above the requirement and equals the wage penalty to those below the requirement of the job (H4). Fifth, based on the job competition theory I formulate the hypothesis that formal education above or below the level of education required for the job show *ceteris paribus* zero return to wages (H5).

### **2.3 Previous research**

In 1976, Freeman (1976) observed for the first time that due to overinvestment in human capital the supply of college graduates exceeds the respective demand in the US. Five years later, Duncan and Hoffman (1981) introduced a theoretical model of educational mismatch which then has been used intensively by many international researchers. Considering the native population, determinants and wage effects of educational mismatch, especially overeducation, have been studied for more than 30 years. Compared to the

large number of papers on native overeducation, evidence on the phenomenon of overeducation in the context of immigrants is relatively sparse.<sup>4</sup>

In a first step, most studies point to a higher incidence of overeducation among immigrants compared to natives. For example, researchers estimate the incidence of male immigrant overeducation at 20.2% to 32.6% for Sweden, at 37.5% for Spain, and at 41.3% to 52.3% for New Zealand.<sup>5</sup> Comparable values for natives are 11.9% for Sweden, 15.0% for Spain, and 36.8% for New Zealand (see Joonas et al. 2014; Fernández and Ortega 2008; Poot and Stillman 2010). Nevertheless, the share of overeducated individuals found in existing research strongly depends on the country studied, immigrant gender, country of origin as well as the arrival cohort and the duration of residence. Further, the incidence of overeducation varies according to the measure of required education used in the analysis (Piracha et al. 2013).

In a second step, previous evidence identifies key factors that correlate significantly with the probability of immigrant overeducation.<sup>6</sup> A common finding is that recent immigrants face a high risk of overeducation which diminishes with years since migration. Especially, labor market experience in the host country as well as language skills are negatively correlated with the probability of being overeducated (see e.g., Chiswick and Miller 2009; Wald and Fang 2008; Joonas et al. 2014; Nielsen 2011). Additionally, the risk of overeducation varies by country of origin (see e.g., Wald and Fang 2008). Wald and Fang (2008) and Joonas et al. (2014) show that a stable family situation, i.e., being married and having young children, is associated with a lower risk of being overeducated. Further,

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<sup>4</sup> For further detail on previous evidence on overeducation with a special focus on immigrants, see e.g., Chiswick and Miller (2009) and Chiswick and Miller (2013) for the US; Wald and Fang (2008) for Canada; Green et al. (2007), Chiswick and Miller (2010), and Poot and Stillman (2010) for Australia and New Zealand; Joonas et al. (2014) for Sweden; Nielsen (2011) for Denmark; Lindley (2009) for the UK; Dell'Aringa and Pagani (2011) for Italy; and Fernández and Ortega (2008) for Spain.

<sup>5</sup> Joonas et al. (2014) show the incidence of overeducation for Sweden conditional on the immigrant's birth region. The lowest value of 20.2% refers to immigrants from South America, whereas the highest value of 32.6% refers to immigrants from North America. Poot and Stillman (2010) calculate the incidence of overeducation for New Zealand by conditioning on the duration of residence. In their analysis, 52.3% of the recent immigrants, i.e. less than five years of residence, and 41.3% of the earlier immigrants, i.e. at least five years of residence, experience overeducation.

<sup>6</sup> As model specifications vary substantially across studies, comparisons between results are difficult. Therefore, this section aims at summarizing possible determinants of the probability of overeducation identified by different papers.

low aggregate unemployment at the time of entry to the host country labor market and working in bigger firms are negatively correlated with the probability of overeducation (Lindley 2009; Joonas et al. 2014).

In a third step, researchers quantify the wage return to required education, the return to overeducation, and the return to undereducation.<sup>7</sup> Most studies additionally calculate the return to attained education. The following general findings of the literature on overeducation hold for both natives and immigrants: a) years of attained education, years of required education, and years of overeducation show on average positive returns, in contrast, years of undereducation show on average negative return; b) the average return to required education is larger than the average return to attained education; c) the average return to overeducation as well as the average return to undereducation is smaller in magnitude than the average return to required education.<sup>8</sup> Comparing patterns for natives and immigrants, previous evidence supports three main findings. First, natives and immigrants show approximately identical returns to required education ranging from about 7% to 8% in Sweden and Denmark to about 15% to 20% in the US, the UK, and Australia. Second, returns to overeducation are higher for natives compared to immigrants. As an example, for Canada, Sweden, and Denmark the returns to overeducation for natives vary between about 5% to 7.5% compared to about 1.5% to 5% for immigrants. Third, natives face a higher penalty from undereducation than immigrants. For example, the returns to undereducation vary between about -3% to -6% for natives compared to about -0.2% to -3% for immigrants in Canada, Sweden, and Denmark (see e.g., Chiswick and Miller 2010; Lindley 2009; Wald and Fang 2008; Joonas et al. 2014; Nielsen 2011).

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<sup>7</sup> Following the notation of the literature on overeducation, *return* to (required-, over-, or under-) education refers to the correlation patterns of log wages and (required-, over-, or under-) education, but not to the respective causal relationships.

<sup>8</sup> A positive coefficient of the wage regression is interpreted as positive return, whereas a negative coefficient is interpreted as negative return.

## 3 Econometric modeling

### 3.1 Measuring required education

Educational mismatch is defined as the deviation of attained education from education required to perform a particular job. More precisely, depending on the direction of deviation a mismatched worker can be either overeducated if the amount of attained education is higher than required, or undereducated if the amount of attained education is lower than required. Thus, it is central to address the issue of how to measure required education. The existing literature on the economics of overeducation developed three alternative measurements: worker self-assessment, professional job analysis, and realized matches method.<sup>9</sup>

The first approach of worker self-assessment is based on information about job requirements the worker directly provides to the interviewer. Alternatively, the worker is asked if she is either overeducated, undereducated, or perfectly matched. On the one hand, this approach deals with up-to-date information, on the other hand exact phrasing of the questions vary over surveys, answers are subjective, and individuals tend to overestimate required education (Hartog 2000).

A more objective measure is the second method which relies on the evaluation of defined occupational categories by professional job analysts. Taking into account the technology of the job, experts assign the type of tasks and the level of required education to each of these occupations (Leuven and Oosterbeek 2011). The Dictionary of Occupational Titles (DOT) is the instrument applied mostly for professional job analyses for the US, whereas for Germany there exists no comparable reference. The main disadvantages of this measurement are high costs to keep information up to date and the risk of measurement errors that can occur when job requirements determined by the experts are translated into a variable measuring the level of required education (Hartog 2000).

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<sup>9</sup> A detailed overview on the different measurements as well as on their advantages and disadvantages can be found in Leuven and Oosterbeek (2011) and Hartog (2000).

The third approach "realized matches" constitutes a purely statistical method and comprises two very similar alternatives, i.e., the mean approach developed by Verdugo and Verdugo (1989) and the mode approach initially implemented by Kiker et al. (1997). Both variants exploit the distribution of attained education in the data set to determine required education as well as the magnitude of educational mismatch. More precisely, required education is calculated separately for specified occupational categories either as the mean (mean approach) or the mode (mode approach) of a worker's attained education. According to the mean approach, a worker is considered as overeducated if her attained education exceeds the mean educational level of the occupational category by more than one standard deviation. Similarly, a worker counts as undereducated if her attained education is lower than the mean educational level of the occupational category minus one standard deviation. As opposed to this, the mode approach defines a worker's mismatch status by comparing the worker's attained education to the modal educational level of the occupational category without considering a two standard deviation interval around the mode. A major drawback of this last measurement is that it uses actual education as a market result of demand and supply, hence, it does not necessarily reflect required education for a specific type of job (Leuven and Oosterbeek 2011).

### **3.2 Determinants of overeducation**

To better understand the phenomenon of overeducation it is essential to measure its determinants. For this purpose researchers use either binary (see e.g., Green et al. 2007; Nielsen 2011; Beckhusen et al. 2013) or multivariate outcome models (see e.g., Wald and Fang (2008) or Battu and Sloane (2004) for multinomial specifications and Lindley (2009) for an ordered specification). Estimation strategies in the literature vary substantially in terms of included covariates and the choice of whether or not to pool groups of individuals (e.g., natives/immigrants or males/females) (Piracha et al. 2013).

The first part of the analysis investigates the determinants of overeducation and uses the following linear probability model:

$$OE_{it} = \alpha_0 + P_{it}' \alpha_1 + C_{it}' \alpha_2 + F_{it}' \alpha_3 + I_{it}' \alpha_4 + \epsilon_{1it}, \quad (1)$$

for individuals  $i = 1, \dots, N$  and time periods  $t = 1, \dots, T$ . Dependent variable is the indicator variable  $OE$  describing the overeducation status of the worker.<sup>10</sup> The independent variables, which are identified by previous literature to correlate with the probability of overeducation, are split into four groups: personal characteristics ( $P$ ), context-specific covariates ( $C$ ), fixed effects ( $F$ ), and immigrant-specific covariates ( $I$ ). Group  $P$  contains individual's work experience, marital status, presence of children, and years of attained education. Covariates such as state unemployment rate, firm size, and size of municipality are considered in group  $C$ . Moreover, the model incorporates state and year fixed effects in group  $F$ . Group  $I$  comprises immigrant's country of origin, years since migration, education attained in Germany, German language skills and whether or not the individual obtained the German citizenship. Since I estimate model 1 separately for natives and immigrants, group  $I$  enters only the specification for immigrants. I use the ordinary least squares (OLS) technique to estimate both specifications.

### 3.3 Wage effects

In the second part of the analysis, I investigate the correlation of educational mismatch with wages. The standard approach in the overeducation literature goes back to [Duncan and Hoffman \(1981\)](#) who extended the standard Mincer wage equation in two steps.

First, years of attained education ( $educ^A$ ) are decomposed into the three components years of required education ( $educ^R$ ), years of overeducation ( $educ^O$ ), and years of undereducation ( $educ^U$ ):

$$educ_{it}^A = educ_{it}^R + educ_{it}^O - educ_{it}^U. \quad (2)$$

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<sup>10</sup>The variable takes the value one if a worker is overeducated and takes the value zero if a worker is either perfectly matched or undereducated.

The years of required education  $educ_{it}^R$  are measured by one of the methods presented in 3.1. The indicator variable  $educ_{it}^O$  takes positive values for overeducated workers ( $educ_{it}^A > educ_{it}^R$ ) and takes the value zero for adequately matched or undereducated workers ( $educ_{it}^A \leq educ_{it}^R$ ). Hence, the years of overeducation are defined as follows:

$$educ_{it}^O = \begin{cases} educ_{it}^A - educ_{it}^R & \text{if } educ_{it}^A > educ_{it}^R \\ 0 & \text{if } educ_{it}^A \leq educ_{it}^R. \end{cases} \quad (3)$$

Similarly,  $educ_{it}^U$  takes positive values for undereducated workers ( $educ_{it}^A < educ_{it}^R$ ) and takes the value zero for adequately matched or overeducated workers ( $educ_{it}^A \geq educ_{it}^R$ ). Thus, the years of undereducation are defined as follows:

$$educ_{it}^U = \begin{cases} educ_{it}^R - educ_{it}^A & \text{if } educ_{it}^A < educ_{it}^R \\ 0 & \text{if } educ_{it}^A \geq educ_{it}^R. \end{cases} \quad (4)$$

Second, replacing  $educ_{it}^A$  in the Mincer wage equation by  $educ_{it}^R$ ,  $educ_{it}^O$ , and  $educ_{it}^U$  gives the ORU (**O**vereducation **R**equired education **U**ndereducation)-specification:

$$\ln(w_{it}) = \beta_0 + \beta_1 educ_{it}^R + \beta_2 educ_{it}^O + \beta_3 educ_{it}^U + X_{it}' \beta_4 + \epsilon_{2it}, \quad (5)$$

where the dependent variable  $\ln(w_{it})$  is the natural logarithm of hourly wage and  $X$  are included control variables. This model allows to estimate simultaneously three types of returns: a) the return to required education  $\beta_1$ , b) the return to overeducation  $\beta_2$ , and c) the return to undereducation  $\beta_3$ . Following the relevant literature, included covariates contain individual's work experience, tenure, marital status, presence of children, firm size, size of municipality, as well as year and state fixed effects. Similarly to the first part

of the analysis described in Section 3.2, the ORU-model is estimated separately for natives and immigrants by OLS. Again, the model specification for immigrants additionally comprises country of origin, years since migration, and German language skills.<sup>11</sup>

## 4 Data and Variables

This paper exploits data from the German Socio-Economic Panel to analyze both the determinants of overeducation and the wage effects of educational mismatch. As a household panel study, the GSOEP contains yearly information on the household level as well as on all household members older than 16. Since 1984, the DIW Berlin provides every year information on about 11,000 households covering 30,000 individuals. Due to detailed micro-level data on education, wages, occupations, and migration background the GSOEP constitutes the most appropriate data base for this analysis with a special focus on Germany.<sup>12</sup>

Following Kleibrink (2013), my sample consists of full-time employed males aged 18 to 65 and covers the years after the German reunification 1991 to 2013.<sup>13</sup> Since the share of immigrants in East Germany is negligible, I restrict the sample to individuals living in West Germany.<sup>14</sup> Similar to the existing literature, the paper focuses on natives and first generation immigrants. Furthermore, individual-year observations without information on either education, occupation, wage, or migration background are deleted. I exclude

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<sup>11</sup> Only few authors address the endogeneity of the educational variables in the wage equation. As both  $educ_{it}^R$ ,  $educ_{it}^O$ , and  $educ_{it}^U$  are endogenous, applying instrumental variable estimations as identification strategy requires at least three valid instruments. For example, Korpi and Tählin (2009) use sibship size, place of residence during childhood, economic problems and disruption in the family of origin as instruments but they turn out being weak. Due to imprecise estimates and aggravated bias due to weak instruments, I opt for the estimation with OLS.

<sup>12</sup> For more information on the GSOEP, please see Wagner et al. (2007).

<sup>13</sup> As especially women with migration background show very different labor market participation behavior compared to their male counterparts, I focus on male individuals (see e.g., Chiswick and Miller 2008; Nielsen 2011).

<sup>14</sup> Micro census data from 2014 show that the average share of immigrants in East German states is less than 10% compared to 10% to 30% or more in West German states (Federal Bureau of Statistics 2014).

individuals who are at the time of interview in apprenticeship, self-employment, or civil service from the sample.<sup>15</sup>

Key variables in my analysis are the educational mismatch variables which are calculated based on the method of realized matches.<sup>16</sup> To limit the impact of outliers, I do not use occupational categories with fewer than ten observations per year. The sample selection described above leads to a final sample of 46,164 individual-year observations for natives and 13,547 individual-year observations for immigrants.<sup>17</sup> The main empirical evidence is based on the realized matches mean approach, whereas robustness tests also exploit the mode approach. Occupational categories are defined based on the International Standard Classification of Occupations 1988 (ISCO-88) given in the GSOEP. Following Bauer (2002), I use a disaggregated two-digit level of the given four-digit occupational categories to ensure a sizable number of observations in each of the occupation-year cells. As required education for a specific occupation may change over time, I calculate it on a yearly basis. After calculating the years of required education per year and occupational category, I define a dichotomous match variable as dependent variable of model 1 and two continuous match variables as explanatory variables of model 5. The logarithm of hourly real gross wages serves as dependent variable of model 5.<sup>18</sup>

Remaining covariates exploited in the analysis are defined and coded as follows. Work experience is approximated by years of potential work experience (age - years of attained education - 6); I use this continuous variable as well as its square. To account for the family situation in the regression, the indicator variables married 1/0 and having children

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<sup>15</sup> Individuals in self-employment are deleted since they experience a different wage structure as other employees of the population. I further exclude civil servants in accordance with the paper of Bauer (2002), who concentrates on Germans. In my analysis with focus on immigrants this group is negligible since only 0.96% of immigrants hold a job as civil servants compared to a value of 12.9% for natives (if civil servants are included in the final sample). Tables A.1 and A.2 in the appendix show additionally that main results presented in Section 5 are not affected by the inclusion of civil servants.

<sup>16</sup> In contrast to the US, Portugal, and the Netherlands there exists no objective measurement of required education for Germany. In the GSOEP, subjective information on required education is rather imprecise as categories are limited to no apprenticeship, apprenticeship, technical college degree, and university degree. Therefore, I do not use worker self-assessment either.

<sup>17</sup> More precisely, the sample contains information on 7,346 natives and 2,236 immigrants with an average observation period of 6.14 years.

<sup>18</sup> Information on hourly wages are not provided in the GSOEP. Thus, I exploit the approximation of monthly wages times 12 divided by weekly working hours times 52.

1/0 are defined. Data for the unemployment rate comes from the Federal Institute for Employment and is measured at the time of interview on the state level.<sup>19</sup> Three binary variables control for firm size (less than 200, between 200 and 2000, and over 2000 employees). Further, I define seven indicators for municipality size, ten state indicators, and 23 year indicators. The countries of origin are categorized in the following eight groups: Turkey, former Yugoslavia, Greece, Italy, Spain, other Europe, Asia, and other world. As years since migration are not directly available in the GSOEP, the variable is calculated as the difference between the year of interview and the year of migration to Germany. To test the hypothesis that investments into host country specific human capital is negatively associated with the probability of overeducation, I calculate potential education and potential experience gained in Germany.<sup>20</sup> Knowing immigrant's age ( $age_{it}$ ), years of attained education ( $educ_{it}^A$ ), age at migration ( $aam_{it}$ ) and assuming school enrollment at age 6, potential education ( $educ_{Germany}$ ) and potential experience ( $exper_{Germany}$ ) in Germany are calculated as follows:

$$educ_{Germany;it} = \begin{cases} educ_{it}^A & \text{if } aam_{it} < 6 \\ educ_{it}^A + 6 - aam_{it} & \text{if } aam_{it} \geq 6 \\ & \text{and } aam_{it} < educ_{it}^A + 6 \\ 0 & \text{if } aam_{it} \geq educ_{it}^A + 6 \end{cases} \quad (6)$$

$$exper_{Germany;it} = \begin{cases} age_{it} - educ_{it}^A - 6 & \text{if } aam_{it} < educ_{it}^A + 6 \\ age_{it} - aam_{it} & \text{if } aam_{it} \geq educ_{it}^A + 6. \end{cases} \quad (7)$$

In the empirical analysis I use the potential share of education (experience) attained in Germany, i.e., the years of education (experience) in Germany divided by the total amount of education (experience) multiplied by 100. The data set further includes information on

<sup>19</sup>For example, Joonas et al. (2014) argue that a stable family situation as well as low aggregate unemployment is correlated with a lower probability of overeducation. Hence, I control for both factors in the analysis.

<sup>20</sup>The GSOEP does not contain information on these measures.

self-assessed German language skills, i.e., speaking and writing competencies, on a scale from 1 ("very good") to 5 ("not at all"). As these two variables show high correlation, I form an indicator that equals one if an immigrant rates at least one of the two competencies as good or very good. Additionally, an indicator measuring whether the immigrant holds the German citizenship is defined.<sup>21</sup>

## 5 Results

### 5.1 Incidence of mismatch and descriptive statistics

Table 1 shows the description of attained education as well as of educational mismatch by immigrant status. German natives attain on average 12.3 years of education, whereas with 10.6 years of education attained in the home country and/or in Germany immigrants are significantly less educated. In addition, required education for the job is on average 1.2 years higher for natives. The overall mean of the years of overeducation is slightly higher for natives, by contrast the average years of undereducation are higher for immigrants. Most studies find in the raw data that immigrants face a higher probability of being overeducated compared to their native counterparts (see e.g., Piracha et al. 2013). For Germany this is not the case as the overall share of overeducation amounts to 14.9% for natives and 10.6% for immigrants. Thus, for the raw data I reject the hypothesis H1.

Although the unconditional probability of being overeducated is lower for immigrants than for natives (see Table 1), the pattern looks different if I condition on education. Table 2 presents in the first two columns the incidence of overeducation separately for natives and immigrants by years of attained education. The last column gives the differences between the averages and the corresponding p-values. Both for natives and immigrants the

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<sup>21</sup> Since for some covariates information is not available for all individuals, missing categories are additionally included for marital status, presence of children, firm size, years since migration, country of origin, and language skills.

risk of overeducation is zero for up to ten years of attained education.<sup>22</sup> However, the risk of overeducation is continuously rising with the level of education up to 61.8% for natives and 66.2% for immigrants with more than 15 years of attained education.<sup>23</sup> For each of the educational categories immigrants show significantly higher incidence of overeducation than natives. The distribution of native and immigrant education illustrated in Table 2 explains the divergence of the unconditional and the conditional risk of overeducation between both groups. Compared to 45.99% of natives, 74.30% of immigrants have no more than 11 years of attained education, which is associated with a low risk of overeducation. Further, only 9.71% of immigrants but 23.36% of natives have more than 13 years of education, which is correlated with a high risk of overeducation. Thus, the comparably low education of immigrants explains why the overall average of immigrant overeducation is smaller. Given the differential distribution of native and immigrant education it is essential and more informative to control for education if determinants of overeducation are analyzed.

Table 3 shows descriptive statistics of covariates used in the analysis separately by immigrant status. Average hourly wages of full-time employed natives amount to 21.5€, full-time employed immigrants by contrast earn on average 16.7€ per hour. As immigrants show lower educational attainment but age does not vary by immigrant status, average potential work experience is higher for immigrants (25.2 years) than for natives (23.7 years).<sup>24</sup> Furthermore, immigrants show less tenure and a higher probability of being married. The most frequent country of origin is Turkey (25.5%) followed by other Europe (20.9%), Asia (13.7%), Italy (12.6%), and former Yugoslavia (12.3%). Immigrants from Greece (6.7%) and Spain (4.4%) are less present. On average, immigrants reside in Germany since 20.1 years, one third holds the German citizenship and two thirds state very

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<sup>22</sup> Using the realized matches mean approach, the minimum of the years of required education plus one standard deviation is 10.799. Consequently, individuals with ten years of attained education or less are never overeducated.

<sup>23</sup> For an international comparison, Poot and Stillman (2010) show years of overeducation (instead of the probability of overeducation) conditional on education for New Zealand. The authors find on average 2.15 to 3.12 years of overeducation for individuals with at least a bachelor degree. In my sample, individuals with at least 13 years of attained education show on average 2.25 years of overeducation.

<sup>24</sup> The average age is 41.8 years for immigrants and 42.0 years for natives.

good German language skills. Age at migration averages at 20.8 years (not shown here), thus, most education is foreign (79.6%). However, 72.6% of the potential experience is gained in Germany.

## 5.2 Determinants of overeducation

To analyze the determinants of overeducation, I estimate model 1 separately for natives and immigrants. Table 4 shows results on coefficients and standard errors, where each column represents one separate regression. Besides the presented covariates, each regression additionally includes year and state fixed effects as well as control variables for municipality size and regional unemployment rate.<sup>25</sup> Further, standard errors are clustered at the individual level.

Column (I) depicts regression results for natives if education is not controlled for. The probability of overeducation is decreasing with work experience, but the slope lowers with the level of experience. In addition, the risk of overeducation diminishes with tenure and increases for married individuals. Both findings are in line with the presented theories as spending time in the labor market enables the individual to find a better job match. Berlingieri and Erdsiek (2012) claim that married individuals show limited geographical mobility due to their working partner, thus, they are willing to accept a worse educational match which is displayed in the positive coefficient of married. In my model, the presence of children in turn has no effect on the probability of being overeducated. This first regression further points to a higher risk of overeducation when working in bigger firms. Column (II) illustrates the necessity to include education as independent variable. The relationship between education and the risk of overeducation is positive and strongly significant. By construction, experience and education are negatively correlated and the inclusion of education lowers the experience coefficient in column (II). Further, if bigger firms attract more educated individuals, the former coefficients on firm size capture the

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<sup>25</sup> Regression results with the full set of control variables are available upon request.

effect of education. Column (II) show that the risk of overeducation is highest for workers with high education, low experience and tenure, working in small firms. Given the negative coefficients of both experience and tenure, I do not reject the hypothesis H2.

Regression results for immigrants with immigrant-specific control variables included in the econometric model are presented in columns (III) to (V). As education is not controlled for in the model shown in column (III), analogous to column (I) the coefficients are different and not further interpreted here. Column (IV) reveals again the positive relationship between education and overeducation. In contrast to natives, experience or tenure in general are not correlated with the risk of overeducation for immigrants. Further, I do not observe differences in overeducation status either by firm size nor by the presence of children. Married immigrants face a higher risk of overeducation compared to their unmarried counterparts even after controlling for education. Individuals from former Yugoslavia find on average a better job match compared to Turkish immigrants, whereas individuals from other countries do not show significant differences regarding the probability of overeducation. Interestingly, holding German citizenship is not correlated with the probability of being overeducated. Not surprisingly, individuals with good or very good German language skills face on average a 3.4 percentage points lower risk of overeducation. Confirming theoretical considerations, spending ten additional years in Germany reduces the probability of overeducation significantly by 3.5 percentage points. Clearly, spending time in the host country decreases the risk of educational mismatch but it remains unsolved to what extent education or experience gained in Germany contribute to this pattern. Model results in column (V) provide insight in how education and experience gained in the host country contribute to the risk of overeducation. Due to collinearity reasons, years since migration is omitted from the regression model. In general, interpreted coefficients are robust to the inclusion of the share of education and the share of experience gained in Germany. Both measures show a strongly negative relationship with the dependent variable. Thus, a ten percentage points increase in the share of education gained in Germany is associated with a 0.49 percentage points decrease in the risk of overeducation. A ten percentage points

increase in the share of experience gained in Germany even leads to a 0.57 percentage points reduction in the probability of overeducation. Interestingly, only experience gained in Germany seems to be negatively associated with the probability of overeducation as the experience coefficient is insignificant. To sum up, German language skills as well as education and experience gained in Germany are essential mechanisms to reduce the risk of immigrant overeducation. Hence, the hypothesis H3 can not be rejected.

### **5.3 Wage effects**

Table 5 shows how attained education and educational mismatch is associated with log hourly wages. Again, I run regression models separately for natives and immigrants. The table only shows relevant coefficients and standard errors which are clustered at the individual level. Columns (I) and (III) present non causal returns to attained education. A one year increase in attained education is associated with 8.4% higher wages for natives and only 4.9% higher wages for immigrants. This finding of higher returns to attained education for natives is in line with previous research (see e.g., Chiswick and Miller 2008).

Columns (II) and (IV) introduce the results for the ORU-model, i.e., when years of attained education are substituted by years of required education, years of overeducation, and years of undereducation. Both for natives and immigrants the patterns of previous research are confirmed for Germany: the coefficients of years of required education and years of overeducation are significantly positive, whereas the coefficient of years of undereducation is significantly negative. This means that years of required education and overeducation are rewarded but in contrast years of undereducation are penalized. Moreover, required education shows a higher return than attained education reflecting that not only education, but to a larger extent educational match is an important driver for wages. Further, both the return to overeducation and the return to undereducation are smaller in magnitude than the return to required education. Thus, overeducated individuals earn on average more and undereducated individuals earn on average less than adequately matched individuals in the same kind of job. However, overeducated individuals earn less

and undereducated individuals earn more than adequately matched individuals with identical educational attainment and holding constant other covariates. For both natives and immigrants I reject the hypothesis H4 ( $\beta_1 = \beta_2 = \beta_3$ ) as well as the hypothesis H5 ( $\beta_2 = \beta_3 = 0$ ).

Comparing natives and immigrants, the return to education for adequately matched individuals, i.e., the return to required education, is about the same for both groups. Natives with one additional year of required education earn on average 11.3% more compared to a value of 10.8% for immigrants. Although the returns to overeducation are positive for both groups, they are half the returns to required education for natives (6.5%) and only about one fifth the returns to required education for immigrants (2.0%). Thus, immigrants suffer even more from being overeducated since for them the difference between the return to required education and the return to overeducation is higher. Regarding the returns to undereducation, the coefficients are negative and smaller in magnitude than the returns to required education. Further, this penalty is lower for immigrants (-3.1%) compared to natives (-4.6%). Comparable results have been found in the literature (see e.g., Chiswick and Miller 2010; Wald and Fang 2008; Lindley 2009).

## 6 Sensitivity tests

This section presents two separate sensitivity tests to investigate the robustness of the main results given in Sections 5.2 and 5.3. First, as results might depend on the measure of required education, I use three alternative approaches to calculate required education: a) inclusion of individual weights before applying the realized matches mean approach,<sup>26</sup> b) applying the realized matches mode approach, and c) applying the realized matches mean approach using occupational classifications on a three-digit level in combination

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<sup>26</sup> As immigrants show a different sampling probability in the GSOEP than natives (Wagner et al. 2007), the use of individual weights might affect the calculation of required education which is based on both natives and immigrants. As required education enters indirectly both model 1 and model 5, I check whether the main results change if individual weights are considered.

with six years windows.<sup>27</sup> Tables 6 and 7 present results on the determinants of overeducation for natives and immigrants, whereas Tables 8 and 9 show respective results on the wage effects when alternatives measures for required education are exploited.<sup>28</sup> Second, I check whether results hold if cross sectional data instead of panel data is exploited since many variables used in the analysis may stay constant over time. Therefore, I use the first observation of the individuals only. Results on the determinants of overeducation and the wage effects using cross sectional data are displayed in Table 10 and 11.<sup>29</sup>

Regarding all robustness checks on the determinants of overeducation for natives (Tables 6 and 10), results change little compared to the baseline estimation. The probability of overeducation is still positively correlated with years of education and negatively correlated with experience and tenure. However, in two specifications the coefficient of experience loses statistical significance. Respective results for immigrants (Tables 7 and 10) support that years of education is positively and that language skills as well as education and experience attained in Germany are negatively associated with the risk of overeducation. A puzzling result is the positive correlation of having a German citizenship and the probability of overeducation found in column (II) of Table 7. Using cross sectional data, the effects of tenure and being married gain statistical significance.

Considering the results of all robustness checks investigating wage effects for both natives and immigrants (Tables 8, 9, 11), I still find in every sensitivity analysis that years of required education and overeducation are rewarded, whereas years of undereducation are penalized. Further, the gain from overeducation as well as the penalty from undereducation is smaller than the gain from required education. Immigrants experience still lower

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<sup>27</sup> Due to small numbers of observations for each of the three-digit level occupational categories per year, it is not possible to calculate required education on a yearly basis. Thus, I assume that required education has not changed over intervals of six years. For the last robustness test mentioned, I calculated required education based on the three-digit level occupational categories for the years 1991 to 1996, 1997 to 2002, 2003 to 2008, and 2009 to 2013.

<sup>28</sup> The model specification of the robustness test investigating the determinants of overeducation includes for both natives and immigrants years of attained education as well as education and experience gained in Germany for immigrants as covariates. Hence, results given in Tables 6 and 7 are comparable to the main results presented in columns (II) and (V) of Table 4.

<sup>29</sup> Again, model specifications for the determinants of overeducation are comparable to the main results presented in columns (II) and (V) of Table 4.

returns to required education and overeducation and face, with one exception, a lower penalty from undereducation compared to natives. To conclude, I argue that the main results are robust to alternative measures of required education as well as to the use of cross sectional data instead of panel data.

## 7 Conclusions

There is ongoing research on educational mismatch, its determinants, and the effects on wages, productivity, satisfaction, and health. However, a growing but still small strand of this literature focuses on the situation for immigrants. Focusing on one of the major immigrant receiving countries in Europe, I investigate incidence, determinants, and wage effects of overeducation for both natives and immigrants in Germany. A key feature of the paper is that the extent of education and experience gained in Germany is considered when analysing determinants of immigrant overeducation.

Using longitudinal data from the GSOEP for the years 1991 to 2013, I find that the probability of overeducation amounts to 14.9% for natives and to 10.6% for immigrants. However, as immigrants are on average less educated than natives, I show that conditional on education immigrants face a higher probability of overeducation. Regarding natives, the probability of overeducation correlates negatively with experience and tenure. The analysis for immigrants highlights that the duration of stay in the host country correlates negatively with the probability of being overeducated. Higher host country specific human capital such as a higher fraction of education and a higher fraction of work experience gained in Germany is associated with a lower risk of overeducation. Interestingly, potential work experience gained in the home country does not help immigrants to reduce the risk of overeducation. Moreover, German language skills determine to a large extent whether or not immigrants suffer from overeducation. Regarding the relationship between educational mismatch and wages, this paper confirms international findings for Germany. Both for natives and immigrants the positive return to required education is higher than

the positive returns to attained education and overeducation, but also higher in magnitude than the negative return to undereducation. Comparing the patterns of both groups, required education is almost equally rewarded for natives and immigrants. However, immigrants face a higher penalty from overeducation, but at the same time a lower penalty from undereducation.

Future research might extend this work in several possible ways. Due to the refugee crisis, the number of asylum applications in Germany has increased by 155.3% between 2014 and 2015 (Federal Office for Migration and Refugees 2015a). Wössmann (2016) hints at the low educational attainment of recently arrived refugees. Hence, it might be interesting to explore patterns of overeducation for refugees as they may have a different educational distribution as individuals in this study. Additionally, it is worth investigating whether educational mismatch status in the home country is associated with educational mismatch status in the host country. Immigrants who already faced overeducation in the home country might have, due to the negative signal of the recent job mismatch, a low probability of escaping from the overeducation status in the host country. Another extension would be the consideration of the difference in development status between home country and host country. Chiswick and Miller (2009) claim that according to the technological change theory the incidence of immigrant overeducation depends on the technological development of the home country relative to the host country. Thus, immigrants from developing countries possibly face a higher risk of overeducation than immigrants from advanced countries. Further attention should be given to educational mismatch dynamics, especially to the state dependence in overeducation. Joona et al. (2014) address this issue and find that state dependence in overeducation is a more severe problem for immigrants than for natives. Additional research for different countries is needed to complement this first analysis on this topic.

## 8 Tables

**Table 1: Description of educational mismatch**

Variables	Natives		Immigrants	
	Mean	Sd	Mean	Sd
Attained education (years)	<b>12.301</b>	2.622	<b>10.606</b>	2.275
Required education (years)	<b>12.200</b>	1.843	<b>10.942</b>	1.393
Overeducation (years)	<b>0.752</b>	1.280	<b>0.535</b>	1.088
Undereducation (years)	<b>0.651</b>	1.033	<b>0.871</b>	1.152
Overeducation (1/0)	<b>0.149</b>	0.356	<b>0.106</b>	0.308
Number of observations	46,164		13,547	

**Source:** GSOEP 1991-2013; own calculations.

**Table 2: Incidence of overeducation by years of attained education**

	Natives	Immigrants	Difference	(p-value)
All	<b>0.149</b> (0.356) 46,164	<b>0.106</b> (0.308) 13,547	<b>0.043</b>	(0.000)
<b>Years of attained education</b>				
Up to 10	<b>0.000</b> (0.000) 3,566	<b>0.000</b> (0.000) 5,333	<b>0.000</b>	(-)
More than 10, up to 11	<b>0.001</b> (0.024) 17,665	<b>0.004</b> (0.062) 4,733	<b>-0.003</b>	(0.000)
More than 11, up to 12	<b>0.064</b> (0.244) 11,257	<b>0.262</b> (0.440) 1,643	<b>-0.198</b>	(0.000)
More than 12, up to 13	<b>0.116</b> (0.320) 1,099	<b>0.341</b> (0.475) 220	<b>-0.225</b>	(0.000)
More than 13, up to 14	<b>0.236</b> (0.425) 1,795	<b>0.444</b> (0.498) 302	<b>-0.208</b>	(0.000)
More than 14, up to 15	<b>0.349</b> (0.477) 3,987	<b>0.559</b> (0.497) 866	<b>-0.210</b>	(0.000)
More than 15	<b>0.618</b> (0.486) 6,795	<b>0.662</b> (0.473) 450	<b>-0.044</b>	(0.063)

**Notes:** The table shows in the first two rows the shares of overeducated individuals, corresponding standard deviations, and the number of observations for the final sample as well as by years of attained education. The last two rows give the differences in means and the corresponding p-values.

**Source:** GSOEP 1991-2013; own calculations.

**Table 3: Descriptive statistics of covariates used in the analysis**

Variables	Natives		Immigrants	
	Mean	Sd	Mean	Sd
Hourly wage (Euro)	<b>21.472</b>	11.760	<b>16.713</b>	6.829
Experience (years)	<b>23.713</b>	10.740	<b>25.211</b>	11.038
Tenure (years)	<b>12.486</b>	10.464	<b>10.791</b>	8.939
Firm size: small (1/0)	<b>0.451</b>	0.498	<b>0.457</b>	0.498
Firm size: medium (1/0)	<b>0.252</b>	0.434	<b>0.306</b>	0.461
Firm size: big (1/0)	<b>0.286</b>	0.452	<b>0.223</b>	0.416
Firm size: missing (1/0)	<b>0.011</b>	0.106	<b>0.014</b>	0.119
Marital status: married (1/0)	<b>0.687</b>	0.464	<b>0.857</b>	0.350
Marital status: not married (1/0)	<b>0.302</b>	0.459	<b>0.134</b>	0.340
Marital status: missing (1/0)	<b>0.010</b>	0.100	<b>0.010</b>	0.097
Presence of children: yes (1/0)	<b>0.611</b>	0.488	<b>0.643</b>	0.479
Presence of children: no (1/0)	<b>0.321</b>	0.467	<b>0.184</b>	0.387
Presence of children: missing (1/0)	<b>0.068</b>	0.251	<b>0.173</b>	0.379
Country of origin: Turkey (1/0)			<b>0.255</b>	0.436
Country of origin: Former Yugosl. (1/0)			<b>0.123</b>	0.329
Country of origin: Greece (1/0)			<b>0.067</b>	0.250
Country of origin: Italy (1/0)			<b>0.126</b>	0.332
Country of origin: Spain (1/0)			<b>0.044</b>	0.206
Country of origin: Other Europe (1/0)			<b>0.209</b>	0.407
Country of origin: Asia (1/0)			<b>0.137</b>	0.344
Country of origin: Other (1/0)			<b>0.028</b>	0.165
Country of origin: missing (1/0)			<b>0.010</b>	0.101
Years since migration (1/0)			<b>20.102</b>	10.677
German citizenship (1/0)			<b>0.345</b>	0.475
Language skills: very good (1/0)			<b>0.636</b>	0.481
Language skills: at best good (1/0)			<b>0.292</b>	0.455
Language skills: missing (1/0)			<b>0.071</b>	0.257
Share educ. attained in Germany (percent)			<b>20.403</b>	35.489
Share exper. gained in Germany (percent)			<b>72.591</b>	28.906
Number of observations	46,164		13,547	

**Notes:** The table displays by immigrant status means and standard deviations of variables used in the analysis.

**Source:** GSOEP 1991-2013; own calculations.

**Table 4: Determinants of overeducation**

	Natives			Immigrants	
	(I)	(II)	(III)	(IV)	(V)
Attained education		0.085 *** (0.002)		0.087 *** (0.004)	0.086 *** (0.004)
Experience (/10)	-0.101 *** (0.015)	-0.022 * (0.012)	0.013 (0.027)	0.014 (0.020)	-0.016 (0.020)
Experience sq. (/100)	0.007 ** (0.003)	0.004 (0.002)	-0.008 * (0.004)	0.002 (0.004)	0.004 (0.004)
Tenure(/10)	-0.012 *** (0.004)	-0.008 ** (0.003)	-0.007 (0.008)	-0.008 (0.007)	-0.010 (0.007)
Married	0.071 *** (0.010)	-0.003 (0.008)	0.051 *** (0.018)	0.023 * (0.014)	0.022 (0.014)
Children	0.010 (0.011)	0.006 (0.008)	-0.006 (0.018)	0.022 (0.015)	0.020 (0.015)
Firm size medium	0.034 *** (0.009)	-0.016 ** (0.007)	0.004 (0.013)	-0.002 (0.011)	-0.001 (0.011)
Firm size big	0.064 *** (0.010)	-0.011 (0.007)	0.021 (0.016)	-0.014 (0.013)	-0.013 (0.013)
Former Yugoslavia			0.020 (0.019)	-0.029 * (0.017)	-0.033 * (0.017)
Greece			0.015 (0.031)	-0.030 (0.020)	-0.031 (0.020)
Italy			-0.001 (0.019)	-0.001 (0.015)	-0.005 (0.015)
Spain			0.004 (0.025)	0.021 (0.024)	0.019 (0.024)
Other Europe			0.145 *** (0.027)	-0.023 (0.021)	-0.025 (0.021)
Asia			0.072 ** (0.031)	-0.037 (0.025)	-0.039 (0.025)
Other			0.211 *** (0.060)	-0.052 (0.046)	-0.055 (0.046)
German citizenship			-0.001 (0.020)	-0.007 (0.017)	-0.005 (0.017)
German language very good			-0.001 (0.012)	-0.034 *** (0.010)	-0.030 *** (0.010)
Years since migration (/10)			-0.072 *** (0.023)	-0.035 * (0.019)	
Years since migration sq. (/100)			0.015 *** (0.005)	0.002 (0.004)	
Share educ. in Germany (/100)					-0.049 *** (0.019)
Share exper. in Germany (/100)					-0.057 * (0.031)
Number of observations	46,164			13,547	

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), regional unemployment rate; standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 5: Wage effects of educational mismatch**

	Natives		Immigrants	
	(I)	(II)	(III)	(IV)
Years of attained education	0.084 *** (0.002)		0.049 *** (0.004)	
Years of required education		0.113 *** (0.002)		0.108 *** (0.005)
Years of overeducation		0.065 *** (0.005)		0.020 *** (0.006)
Years of undereducation		-0.046 *** (0.004)		-0.031 *** (0.006)
Number of observations	46,164		13,547	

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), experience (squared), married 1/0, children 1/0, firm size (2 categories), tenure, state unemployment rate, German language skills (very) good 1/0, years since migration (squared), country of origin (7 categories); standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 6: Determinants of overeducation using alternative measures of required education (natives only)**

	Mean (weighted)	Mode	Mean ISCO3
	(I)	(II)	(III)
Years of education	0.090 *** (0.002)	0.020 *** (0.002)	0.082 *** (0.002)
Experience (/10)	-0.030 ** (0.012)	-0.007 (0.020)	-0.009 (0.013)
Experience squared (/100)	0.005 ** (0.002)	-0.010 ** (0.004)	0.001 (0.002)
Tenure (/10)	-0.006 ** (0.003)	0.003 (0.007)	-0.009 *** (0.003)
Married 1/0	-0.005 (0.008)	-0.010 (0.014)	0.004 (0.008)
Children 1/0	0.004 (0.008)	-0.015 (0.014)	0.005 (0.008)
Number of observations	46,164		

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), firm size (2 categories), state unemployment rate; standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 7: Determinants of overeducation using alternative measures of required education (immigrants only)**

	Mean (weighted) (I)	Mode (II)	Mean ISCO3 (III)
Years of education	0.087 *** (0.004)	0.109 *** (0.006)	0.085 *** (0.004)
Experience (/10)	-0.020 (0.020)	-0.007 (0.033)	-0.021 (0.021)
Experience squared (/100)	0.004 (0.003)	-0.005 (0.006)	0.004 (0.004)
Tenure (/10)	-0.009 (0.007)	0.011 (0.011)	-0.005 (0.007)
Married 1/0	0.014 (0.014)	0.016 (0.024)	0.022 (0.014)
Children 1/0	0.022 (0.014)	0.002 (0.024)	0.026 (0.016)
Former Yugoslavia	-0.032 * (0.017)	0.128 *** (0.031)	-0.012 (0.018)
Greece	-0.028 (0.020)	-0.039 (0.037)	-0.041 ** (0.019)
Italy	-0.004 (0.015)	0.060 ** (0.027)	-0.002 (0.015)
Spain	0.018 (0.024)	0.054 (0.037)	-0.006 (0.023)
Other Europe	-0.025 (0.021)	0.012 (0.035)	-0.025 (0.022)
Asia	-0.044 * (0.024)	-0.031 (0.043)	-0.048 * (0.025)
Other	-0.032 (0.047)	-0.226 *** (0.068)	-0.033 (0.047)
German citizenship	-0.010 (0.017)	0.092 *** (0.029)	-0.008 (0.018)
Language skills (very) good	-0.032 *** (0.010)	-0.030 * (0.017)	-0.038 *** (0.015)
Share educ. in Germany (/100)	-0.048 *** (0.019)	-0.138 *** (0.033)	-0.053 *** (0.029)
Share exper. in Germany (/100)	-0.055 *** (0.030)	-0.147 *** (0.050)	-0.098 *** (0.044)
Number of observations		13,547	

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), regional unemployment rate; standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 8: Wage effects of educational mismatch using alternative measures of required education (natives only)**

	Mean (weighted) (I)	Mode (II)	Mean ISCO3 (III)
Years of required education	0.115 *** (0.002)	0.089 *** (0.002)	0.110 *** (0.002)
Years of overeducation	0.065 *** (0.005)	0.078 *** (0.003)	0.064 *** (0.005)
Years of undereducation	-0.046 *** (0.004)	-0.050 *** (0.003)	-0.039 *** (0.004)
Number of observations	46,164		

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), experience (squared), married 1/0, children 1/0, firm size (2 categories), tenure, state unemployment rate; standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 9: Wage effects of educational mismatch using alternative measures of required education (immigrants only)**

	Mean (weighted) (I)	Mode (II)	Mean ISCO3 (III)
Years of required education	0.111 ** (0.005)	0.076 *** (0.003)	0.104 *** (0.005)
Years of overeducation	0.021 *** (0.006)	0.035 *** (0.006)	0.018 *** (0.006)
Years of undereducation	-0.030 *** (0.005)	-0.028 *** (0.005)	-0.027 *** (0.006)
Number of observations	13,547		

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), experience (squared), married 1/0, children 1/0, firm size (2 categories), tenure, state unemployment rate, German language skills (very) good 1/0, years since migration (squared), country of origin (7 categories); standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 10: Determinants of overeducation using cross sectional data**

	Natives (I)	Immigrants (II)
Years of attained education	0.085 *** (0.002)	0.086 *** (0.004)
Experience (/10)	-0.033 ** (0.013)	-0.014 (0.023)
Experience squared (/100)	0.006 ** (0.003)	0.004 (0.004)
Tenure(/10)	-0.011 *** (0.004)	-0.016 * (0.009)
Married 1/0	-0.005 (0.009)	0.038 ** (0.016)
Children 1/0	0.012 (0.009)	0.010 (0.017)
Former Yugoslavia		-0.018 (0.020)
Greece		-0.030 (0.020)
Italy		0.002 (0.016)
Spain		-0.013 (0.029)
Other Europe		-0.012 (0.024)
Asia		-0.007 (0.029)
Other		-0.019 (0.041)
German citizenship		-0.008 (0.022)
Language skills (very) good		-0.059 *** (0.014)
Share educ. attained in Germany (/100)		-0.036 * (0.021)
Share exper. attained in Germany (/100)		-0.041 (0.032)
Number of observations	7,346	2,236

**Notes:** Models also include state indicators (9), size of municipality (6 categories), regional unemployment rate; standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table 11: Wage effects of educational mismatch using cross sectional data**

	Natives		Immigrants	
	(I)	(II)	(III)	(IV)
Years of attained education	0.078 *** (0.002)		0.057 *** (0.004)	
Years of required education		0.105 *** (0.003)		0.111 *** (0.006)
Years of overeducation		0.061 *** (0.004)		0.017 *** (0.007)
Years of undereducation		-0.040 *** (0.006)		-0.049 *** (0.008)
Number of observations		7,346		2,236

**Notes:** Models also include state indicators (9), size of municipality (6 categories), experience (squared), married 1/0, children 1/0, firm size (2 categories), tenure, state unemployment rate, German language skills (very) good 1/0, years since migration (squared), country of origin (7 categories); standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

## A Appendix

**Table A.1: Determinants of overeducation: civil servants included in the final sample**

	Natives		Immigrants		
Attained education		0.080 *** (0.002)		0.086 *** (0.004)	0.085 *** (0.004)
Experience (/10)	-0.092 *** (0.015)	-0.028 ** (0.012)	0.016 (0.026)	0.015 (0.020)	-0.015 (0.020)
Experience sq. (/100)	0.005 * (0.003)	0.004 * (0.002)	-0.008 * (0.004)	0.001 (0.003)	0.003 (0.003)
Tenure(/10)	-0.006 (0.004)	-0.004 (0.003)	-0.005 (0.008)	-0.007 (0.007)	-0.010 (0.007)
Married	0.059 *** (0.010)	-0.008 (0.007)	0.047 *** (0.018)	0.019 (0.014)	0.017 (0.014)
Children	0.013 (0.010)	0.006 (0.007)	-0.011 (0.018)	0.019 (0.014)	0.017 (0.014)
Firm size medium	0.035 *** (0.009)	0.003 (0.007)	0.004 (0.013)	0.000 (0.011)	0.000 (0.011)
Firm size big	0.054 *** (0.010)	0.018 ** (0.007)	0.020 (0.016)	-0.012 (0.013)	-0.011 (0.012)
Civil servant	-0.005 (0.013)	-0.173 *** (0.012)	-0.108 ** (0.050)	-0.398 *** (0.058)	-0.390 *** (0.057)
Former Yugoslavia			0.017 (0.019)	-0.030 * (0.017)	-0.034 ** (0.017)
Greece			0.012 (0.030)	-0.032 (0.020)	-0.033 * (0.020)
Italy			-0.003 (0.019)	-0.002 (0.015)	-0.006 (0.015)
Spain			0.000 (0.025)	0.017 (0.024)	0.017 (0.024)
Other Europe			0.143 *** (0.027)	-0.019 (0.021)	-0.022 (0.021)
Asia			0.070 ** (0.031)	-0.033 (0.025)	-0.035 (0.025)
Other			0.217 *** (0.059)	-0.037 (0.045)	-0.041 (0.045)
German citizenship			-0.005 (0.021)	-0.014 (0.017)	-0.012 (0.017)
German language very good			0.003 (0.012)	-0.030 *** (0.010)	-0.026 *** (0.010)
Years since migration (/10)			-0.073 *** (0.023)	-0.035 * (0.019)	
Years since migration sq. (/100)			0.015 *** (0.005)	0.002 (0.004)	
Share educ. in Germany (/100)					-0.053 *** (0.019)
Share exper. in Germany (/100)					-0.053 * (0.031)
Number of observations	53,124		13,694		

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), regional unemployment rate; standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

**Table A.2: Wage effects of educational mismatch: civil servants included in the final sample**

	Natives		Immigrants	
	(I)	(II)	(III)	(IV)
Years of attained education	0.083 *** (0.002)		0.050 *** (0.004)	
Years of required education		0.109 *** (0.002)		0.109 *** (0.005)
Years of overeducation		0.068 *** (0.004)		0.019 *** (0.006)
Years of undereducation		-0.039 *** (0.004)		-0.032 *** (0.006)
Number of observations		53,124		13,694

**Notes:** Models also include year indicators (22), state indicators (9), size of municipality (6 categories), experience (squared), married 1/0, children 1/0, firm size (2 categories), tenure, state unemployment rate, civil servant 1/0, German language skills (very) good 1/0, years since migration (squared), country of origin (7 categories); standard errors in parentheses are clustered at the individual level. \*\*\*, \*\* and \* indicate statistical significance at the 1%, 5% and 10% level.

**Source:** GSOEP 1991-2013; own calculations.

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