Le-Quang and Vallizadeh *J Labour Market Res* (2022) 56:8
https://doi.org/10.1186/s12651-022-00314-7

Journal for Labour Market Research

ORIGINAL ARTICLE Open Access

The returns to school-quality-adjusted education of immigrants in Germany

Huy Le-Quang[1*] and Ehsan Vallizadeh[2]

Abstract

This paper explores the role of school quality in immigrants' home countries on their earnings in Germany, using native Germans as a benchmark. We propose an empirical analysis that highlights two important insights. First, there is a substantial gap in the returns to education between natives and immigrants in Germany, especially when we consider the quality of schooling in the source country where education was obtained. In particular, lower school quality reduces the endowment advantage that immigrants possess from their education. Second, quality-adjusted education helps us to better understand the potential driving force behind the native–immigrant wage gap. We show that this measure accounts for a substantial fraction of the unexplained part in the Oaxaca–Blinder decomposition. These findings emphasize the role of the school quality in explaining the imperfect transferability of human capital of immigrants in Germany.

Keywords: School quality, Wage gap decomposition, Immigration, Earnings

JEL Classification: I21, I26, J31, J61

1 Introduction

In the aftermath of the financial crisis in 2009, Germany experienced a surge of immigration with an average annual net flow of approximately 300,000 people, a clear majority of whom came from new member states of the European Union (Dustmann et al. 2012). This considerably changed the composition of source countries, indicating a shift towards European immigrants, and a skill structure marked by higher skill levels of immigrants in Germany (Muysken et al. 2015). A major challenge of integrating immigrants into the host country are barriers to the transferability of human capital endowments and their educational skills (Chiswick and Miller 2008). It is well-known from empirical evidence that these barriers explain a substantial part of the native–immigrant wage gap (Friedberg 2000). In this paper, we show that one of the key factors characterizing the limitation of human capital transferability is the quality of schooling in immigrants' source countries.

The majority of existing evidence on the native–immigrant wage gap considers education obtained abroad as a perfect substitute for the education in the host country (Basilio et al. 2017). However, one year of schooling in the host country might effectively be equal to more or less than a year of schooling in other countries. Therefore, it is crucial to consider not only the years of education but also the quality of these years of education (Rohrbach-Schmidt and Tiemann 2016; Wößmann 2003).

In this paper, we deviate from the conventional approach and provide an important measure that accounts for the differences in the quality of human capital endowments between the host and source countries of immigrants. We examine the wage assimilation of immigrants in Germany and the determinants of the native–immigrant wage gap. We adjust the educational level of immigrants by using the school quality index of Hanushek and Kimko (2000). The goal of this paper is to understand how the pattern of the wage growth changes when the school quality index is taken into account. In

*Correspondence: huy.le@gmx.de

[1] Otto–Friedrich University of Bamberg, Bamberg, Germany
Full list of author information is available at the end of the article

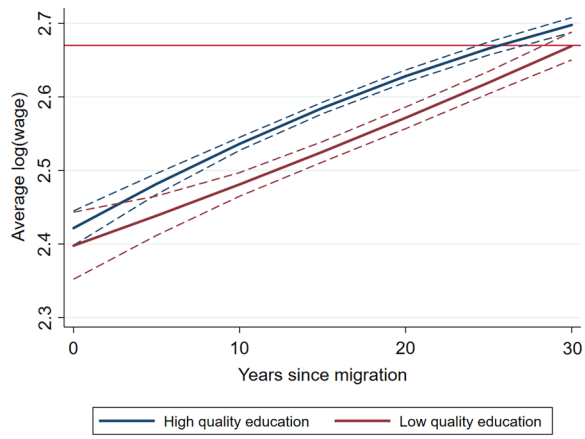

Fig. 1 Wage assimilation of foreign-educated immigrants (Total sample). Sample of individuals aged 18 to 64, having full-time or regular part-time employment. The (unadjusted) wage assimilation over the time since the migration of immigrants educated in foreign countries before arriving in Germany. The dotted lines represent the 95 percent confidence interval. The red horizontal line on top illustrates the mean wage of natives over time. Sources: German Socio-Economic Panel (GSOEP) (wave: 1984–2016), version 33, released in 2018

Fig. 1 we explore data from the German Socio-Economic Panel (wave: 1984–2016) to decompose the wage assimilation pattern of immigrants into low-quality and high-quality schooling groups[1]. As illustrated in this figure, upon arrival, both groups of immigrants have, on average, lower wages than natives. However, immigrants who obtained their education in countries with high schooling quality have higher wages than the other immigrant group. Moreover, the rate at which they catch up to natives is faster for the high-quality schooling group of immigrants. On average, their wages converge approximately 8 years faster to natives' wage level than the low-quality schooling group of immigrants.

From this interesting observation, this paper attempts to improve the understanding of the role of schooling quality on the native–immigrant wage gap. Particularly, two key questions at the core of our analysis are (1) How does the school quality of immigrants' source countries affect the returns to education? (2) How does school quality impact the native–immigrant wage gap?

Using a large, representative household dataset—the Germany Socio-Economic Panel (GSOEP) 1984–2016—we show that a substantial part of the unexplained wage gap decomposition is explained by the school quality in the source countries of immigrants. Further, these data provide detailed information about the pre- and post-migration educational activities of immigrants, which serves as a basis to understand the differences in the returns to education in Germany and the returns to education abroad. Unlike Coulombe et al. (2014), who use gross domestic product (GDP) as a proxy for school quality, or Basilio et al. (2017), who do not adjust the quality of foreign schooling in their wage estimations, we use a direct measure of school quality to calculate the effective years of schooling of immigrants in Germany. In particular, we first split the total years of education into years studying abroad and years studying in Germany. Next, we adjust years studying abroad by using the Hanushek and Kimko (2000) school quality index.

This approach is suited for the empirical analysis for a number of reasons. First, although GDP has a strong correlation with the amount of resources allocated to education, the question is whether this indicator measures the quantity rather than the quality of schooling. Furthermore, there could be a reverse causality where higher human capital leads to higher GDP (Hanushek 2005). Second, unlike contemporary school quality data such as PISA or PIACC[2] scores, the Hanushek and Kimko (2000) school quality index is a comprehensive indicator, which is constructed based on six voluntary international standardized tests in mathematics and science conducted between 1965 and 1991. Therefore, it can potentially better capture the time during which immigrants in the sample actually went to school in their home countries[3].

Our empirical findings provide two novel insights. First, we show that the returns to quality-adjusted education are positive but significantly less than the returns to the unadjusted education of immigrants in Germany.

[1] The low-quality schooling group consists of immigrants from countries for which the Hanushek and Kimko (2000) school quality index is smaller than the first quartile of the school quality index distribution (i.e., where the school quality index equals 46.77). The high-quality schooling group consists of immigrants from countries for which the Hanushek and Kimko (2000) school quality index is larger than or equals 46.77. The Hanushek and Kimko (2000) quality index, which is constructed based on international standardized tests in mathematics and science, offers the opportunity to differentiate between low- and high-quality schooling countries.

[2] PISA (Program for International Student Assessment) from the OCED measures 15-year-old students' ability to use their reading, mathematics and science knowledge and skills to meet real-life challenges. The tests have been conducted in more than 90 countries since 2000 and organized every three years (OECD 2022a). The Program for the International Assessment of Adult Competencies (PIAAC) developed and conducts the Survey of Adult Skills. The survey measures adults' proficiency in key information-processing skills—literacy, numeracy and problem solving in technology-rich environments—and gathers information and data on how adults use their skills at home, at work and in the wider community. The PIACC was initiated in 2008 (OECD 2022b).

[3] One disadvantage of using this observed measure of cognitive skills is that there are confounding factors outside of formal schools such as home background or social background factors other than the instructional characteristics of schools that we cannot control for (Hill and Rowe (1996) and Hanushek and Kimko (2000)).

This finding shows that lower school quality negates the endowment advantage that immigrants possess from their education. Second, there is a wage gap between natives and immigrants, and education plays an important role in explaining this earnings difference. Existing studies often use wage gap decomposition methods breaking down mean wage differentials into explanatory determinants and an unexplained part. The interpretation of the unexplained component is vulnerable because it captures a range of factors, such as discrimination effects and unobserved individual or institutional characteristics. Our analysis reveals that controlling for school quality allows to account for important institutional characteristics. This factor significantly reduces the unexplained wage gap. Ultimately, our results highlight the role of school quality in understanding the international transferability of human capital and the returns to education of immigrants in the host country.

Ever since the seminal research of Card and Krueger (1992) on the causal relationship between school quality and earnings in the United States, economists have used different measures of school quality to investigate its transmission mechanism to earnings. The quantity of schooling, which represents resources devoted to education such as the pupil–teacher ratio, expenditures per pupil, relative wages of teachers, and the length of school term, is easily measured, and data are widely available (Hanushek 2005). However, the central concern in contemporary education policy revolves much more around the quality of schooling. Compared to the quantity of schooling, the measurement of school quality is more challenging. This is because the question is whether we can assume international standardized test scores to be an appropriate measure of cognitive skills affected by the quality of schooling and whether students' performance on these standardized tests has any correlation with economic outcomes such as their subsequent labour market performance (Hanushek 2005).

Nevertheless, Chiswick and Miller (2010) and Coulombe et al. (2014) still attempt to use different measures of school quality such as the PISA score and the national GDP to explain the relatively lower labour market performance of immigrants in host countries. Raaum (1998) and Friedberg (2000) estimate the return to foreign schooling of immigrants in Norway and Israel, respectively. They find a significantly lower return to foreign education than to host-country education. Betts and Lofstrom (2000), Bratsberg and Ragan Jr (2002), Bratsberg and Terrell (2002) and Chiswick and Miller (2010) investigate the payoff of schooling for immigrants in the United States, and Sweetman (2004) and Fortin et al. (2016) do so in Canada and find that the quality of the educational system obtained abroad accounts for a large fraction (from 30 to 80 percent) of the variation in the rates of return to education not only between immigrants and natives but also between immigrants who acquire education in the host countries and those who do not. In other words, the lower partial effect of schooling on earnings for immigrants from less developed countries is due to lower quality of foreign schooling, even after allowing for differences in working experience and other factors that might influence earnings.

Low international transferability of skills is a potential explanation for the poor labour market outcomes of immigrants in a host country due to large differences in human capital quality across countries (Friedberg 2000; Chiswick and Miller 2009, 2010; Aleksynska and Tritah 2013; Basilio et al. 2017). In particular, the differences in schooling systems, unrecognized qualifications, technological development, and other barriers to labour market entry could adversely affect international skill transferability (de Oliveira et al. 2000; Aleksynska and Tritah 2013).

This paper contributes to the literature in several important ways. First, we use an alternative measure of years of education obtained abroad that adjusts for the quality of schooling in the source country of migration. In this way, we are able to compute plausible and precise estimates of the returns to education of immigrants in the host country. Second, we use a large representative panel dataset, covering a long period until 2016, which allows us to include recent immigration flows to Germany, such as the refugee influx in 2015 (Eurostat 2018). Third, using a Oaxaca–Blinder decomposition model, we show that using a quality-adjusted measure of education substantially reduces the unexplained part of the native–immigrant wage gap by approximately 20 percent. Thus, our approach reveals that school quality appears to be a major factor in explaining the imperfect transferability of human capital and decreases the level of "ignorance" often attributed to "discrimination" in previous literature.

Nevertheless, another challenge in estimating the returns to education is the omitted variable bias that may arise due to unobservable variables, for example, family background, innate ability, motivation, and other non-cognitive skills. We assume that the direction of this bias is the same for both immigrants and natives. Under this assumption, we can compare the returns to education among natives, German-educated immigrants and foreign-educated immigrants.

The paper proceeds as follows. Section 2 presents our empirical strategies. Section 3 introduces the dataset and our key variables for analysis. Section 4 analyses the empirical findings and provides some insights of the results. Section 5 concludes the paper.

2 Empirical strategy

We propose an empirical analysis that consists of two consecutive steps. In the first step, we estimate the differences in returns to total years of education between natives and immigrants using a Mincerian earnings equation. The mean natural logarithm of hourly wages of natives and immigrants in Germany is thus represented by the following two equations:

$$ln(w_N) = \beta_0 + \beta_1 Educ_N + \beta_2 Exp_N + \beta_3 Exp_N^2 + \beta_4 X_N + \beta_5 s + \beta_6 t + \epsilon_N \quad (1)$$

$$ln(w_I) = \alpha_0 + \alpha_1 Educ_I + \alpha_2 Exp_I + \alpha_3 Exp_I^2 + \alpha_4 X_I + \alpha_5 s + \alpha_6 t + \alpha_7 c + \eta_I \quad (2)$$

Let the subscripts N and I denote natives and immigrants, respectively; *Educ* denotes total years of education; *Exp* denotes years of experience with the current firm in Germany; X denotes a vector of other control variables (gender, marital status, age, age squared, years since migration, years since migration squared, German language skills, establishment size and industry dummies); s denotes federal state fixed effects; t denotes the survey year fixed effects; c denotes the country of origin fixed effects; and ϵ and η denote idiosyncratic error terms. We control for these fixed effects to capture the common development in a specific state or country and at a specific point in time.

The only difference between these two equations is that for foreign-educated immigrants, we adjust the quality of schooling for the years of education abroad, while we do not do so for natives and German-educated immigrants.

In the second step of our analysis, we decompose the native–immigrant wage gap using Oaxaca–Blinder decomposition method (Blinder 1973; Oaxaca 1973). This method separates the wage gap into the explained component due to differences in observed characteristics between natives and immigrants and the unexplained component often attributed to discrimination or differences in unobserved characteristics between natives and immigrants.

$$\underbrace{ln(w_I) - ln(w_N)}_{\text{mean wage gap}} = \underbrace{(X_I - X_N)\beta_N}_{\text{explained by means of regressors}} + \underbrace{(\beta_I - \beta_N)X_I}_{\text{unexplained component}}$$

The first term on the right-hand side of this equation measures the explained component of the wage gap. This component includes the portion of the wage gap due to differences in the observed characteristics of immigrants and natives, evaluated by the coefficients of the natives. The second term on the right-hand side of the equation measures the unexplained component of the wage gap. This component tells us that a native–immigrant wage gap persists even when natives and immigrants are alike in terms of their observable attributes. In other words, this component is often referred to as "discrimination" in the literature.

In this analysis, we present our baseline estimates using unadjusted education and compare the results with the quality-adjusted years of education. In doing so, we show that using the adjusted years of education provides more plausible estimates and reduces the unexplained difference in earnings and thus improves our understanding of the native–immigrant wage gap.

As mentioned previously, the estimation of the returns to education using Mincerian regression brings about several challenges. First, years of education and the school quality index may be subject to measurement errors. Particularly, the years of education in the GSOEP are self-reported and converted from the highest qualification attained, which may induce problems of heterogeneous reporting behaviours. The school quality index is assumed to be constant over the sampling period but may change over time in practice.

Second, our estimation may suffer from omitted variable bias because we are unable to observe and measure innate ability, motivation, and non-cognitive skills. Years of experience with the current firm in Germany, or tenure, is also potentially an endogenous variable. Burdett (1978) and Jovanovic (1979) show in theoretical search models that a high-productivity job–skill match is unlikely to end and that firm tenure is positively correlated with employees' productivity and wages. Likewise, establishment size and industry may also be endogenous because workers can self-select into certain industries and establishments of a given size.

Systematic measurement errors may be of concern if there are systematic differences in reporting heterogeneity or unobservable characteristics across population groups. Since our empirical strategy is to compare returns to education obtained abroad with returns to education obtained in Germany, the problem of systematic reporting bias or omitted variable bias should be less

of a concern. This is particularly true if we assume that there are not many differences in unobserved characteristics explaining the educational attainment levels between individuals who obtained their education abroad and those who obtained their education in Germany. To overcome some of the heterogeneity problems, we add country of origin fixed effects and federal state fixed effects to control for migration motives and regional economic conditions, respectively.

3 Data and variables

3.1 The German socio-economic panel (GSOEP)

We use the German Socio-Economic Panel (GSOEP) for the years 1984–2016. The German Socio-Economic Panel (SOEP) is a wide-ranging representative longitudinal study of private households, conducted by the German Institute for Economic Research, DIW Berlin. Starting from 1984, every year in Germany, approximately 25,000 respondents in nearly 15,000 households are interviewed by Kantar Public Germany (Wagner et al. 2007). The data provide information on all household members, consisting of Germans living in the Old and New German States, foreigners, and recent immigrants to Germany.[4] One of the advantages of this dataset is that it has rich information at the individual level about education and labour market performance. This allows us to account for different individual characteristics when we compare the labour market performance of immigrants and natives.

Immigrants are defined as people who were born outside Germany or have at least one parent with a migration background (Bundesministerium für Bildung und Forschung 2019). We consider individuals who are between 18 and 64 years old and are employed on either a full- or regular part-time basis. We exclude people in education, retirement, civil or military service and self-employment because of their irregular employment activities and unreliable wage information. After applying these sample selection criteria, we are left with 224,867 person–year observations (188,065 natives and 36,802 immigrants).

3.2 Variables

The natural logarithm of hourly wages measures the financial rewards of a job, which may reflect the individual productivity or the returns to skills and education of an individual. Using the GSOEP data, we compute the logarithm of hourly wages from the self-reported gross monthly wages and working hours per week. We deflate the wage variable to 2010 prices. To prevent the effects of outliers that could bias our estimation results, we winsorize wages at the 5*th* and 95*th* percentiles. That is, we set all data below the 5*th* percentile to the 5*th* percentile and data above the 95*th* percentile to the 95*th* percentile—a method documented by Amann and Klein (2012).

Years of quality-adjusted education[5] is the single most important variable in this research. One drawback of the survey data is that they do not contain information about the source country where immigrants obtained their education; hence, we make the following assumptions. First, all native Germans and immigrants who migrated to Germany before the age of six acquire education exclusively in Germany. These immigrants are called German-educated immigrants. Second, for immigrants who migrated to Germany after the age of six, we observe whether they either acquire education exclusively in their home countries or partly in Germany and partly in their home countries. [6] These immigrants are called foreign-educated immigrants. For the foreign-educated immigrants, we split the total years of education into years studying abroad and years studying in Germany based on their age at migration and adjust the quality of schooling accordingly. We normalize the Hanushek and Kimko (2000) school quality index to the German level by dividing the school quality of country c by that of Germany as follows:

$$q_c = \frac{SQ_c}{SQ_{DE}}$$

This normalization of the index implies that the school quality in Germany is 1 and the school quality in other countries could be smaller or larger than 1 depending on whether the quality of education in those countries is better or worse than that in Germany.

3.3 The Hanushek and Kimko (2000) school quality index

The Hanushek and Kimko (2000) quality index is constructed based on six voluntary international standardized tests in mathematics and science conducted between 1965 and 1991. Altogether, they use information about 26

[4] This paper uses data from the Socio-Economic Panel (SOEP) for the years 1984–2016, version 33, released in 2018, doi:https://doi.org/10.5684/soep.v33.

[5] We do not differentiate primary/secondary schooling quality from tertiary education quality (quality of vocational training and universities) in our adjustment process. This is in line with empirical findings showing a highly positive correlation between primary/secondary education and higher education. Michaelowa (2007) argues that the primary and secondary education systems of a country influence the knowledge and attitudes of individuals who enter higher education. In other words, without a pool of qualified secondary graduates, one is unlikely to have a qualified pool of students available for higher education. Using PISA scores to compute primary/secondary education quality and two alternative university rankings for tertiary education quality, she finds a positive relationship between the primary/secondary education and tertiary education quality. This positive relationship remains strong after adding other control variables such as GDP, population, and enrolment rates.

[6] We assume that immigrants do not study in a third country.

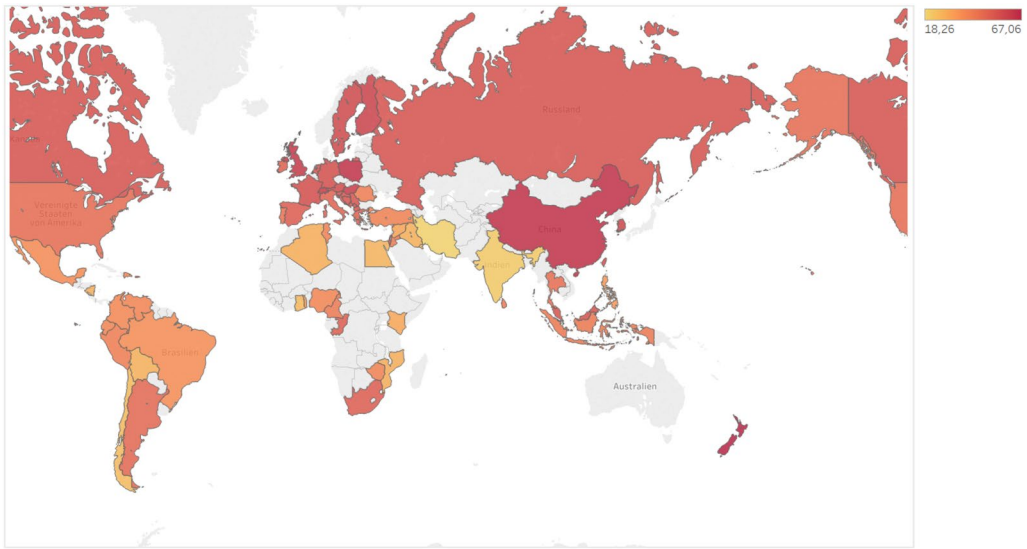

Fig. 2 Hanushek and Kimko (2000) School quality index. Sources: Hanushek and Kimko (2000)

separate test score series from different age groups, subfields and years to generate human quality indices for 39 countries participating at least once in these international tests and extrapolate to other 111 countries based on information provided in the National Assessment of Educational Progress (NAEP) (Hanushek and Kimko 2000; Wößmann 2003). The resulting quality measure reflects the weighted average of all test scores available for each country where the weights are the normalized inverse of the country-specific standard error of each test, assuming that the higher the standard error is, the less accurate the information it conveys (Wößmann 2003). This list lacks some countries in Eastern Europe; consequently, by matching the country-level data with the individual-level data, the number of countries decreases to 87.

Figure 2 displays the summary of the constructed school quality index for different regions. The overall mean is 51.28, and the median is 46.77 with a standard deviation of 13.48. Countries in the Asian–Oceanian region have the largest range of school quality: from 20.80 in India to 67.06 in Singapore. Generally speaking, countries in East Asia such as Japan, Hong Kong, Singapore, China and Taiwan consistently have the highest ranking throughout the period from 1965 to 1991 (the maximum score is 67.06). In the bottom are countries in Latin America (Chile, El Salvador, Paraguay) and Africa (Algeria, Bahrain, Ghana). The country with lowest score is Iran at 18.26 points. Germany has a slightly higher score than the mean score of all countries (55.74 compared to 51.28).

3.4 Summary statistics

Table 1 presents summary statistics for the full sample of natives and the two groups of immigrants under study. In the foreign-educated immigrant group, we further split by countries with a high quality of schooling and countries with a low quality of schooling.

Figure 3 shows that natives have, on average, slightly higher wages than both groups of immigrants. This figure also shows that the wage distribution of immigrants has longer tails than that of natives, indicating that immigrants' wages are more extreme than those of natives. Having a longer tail on the left-hand side (below 2.14) also means that there are many immigrants earning less than the minimum wage in 2016.[7] Table 1 shows that while the mean difference in wages between natives and German-educated immigrants is only 0.1 log points, the mean difference in wages between natives and foreign-educated immigrants from countries with a high quality of schooling is 7.4 log points and that between natives and immigrants from countries with a low quality of schooling is 10.9 log points (equivalent to 1 and 1.12 euros per hour, respectively).

While the years of unadjusted education for natives is higher than those for immigrants (12.48 and 11.36 respectively), this result is reversed when we take the years of quality-adjusted education into consideration (12.48 and 13.63, respectively). This result seems surprising at first; however, when we separate the foreign-educated immigrants into two sub-groups, those

[7] The minimum wage in Germany in 2016 was 8.50 euros.

Table 1 Summary statistics. Source: SOEP (wave: 1984–2016), version 33, released in 2018

Variables	Natives		German-educated immigrants		Foreign-educated immigrants			
					Low quality		High quality	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Log(hourly wages)	2.678	0.525	2.677	0.504	2.569	0.430	2.604	0.444
Years of education (unadjusted)	12.488	2.561	12.226	2.711	10.097	2.250	11.034	2.421
Years of education (adjusted)	12.488	2.561	12.226	2.711	9.967	2.442	15.762	3.690
Males	0.543	0.498	0.564	0.495	0.728	0.444	0.550	0.497
Married	0.668	0.470	0.555	0.496	0.887	0.316	0.807	0.394
Age	42.266	10.498	36.192	10.512	39.544	9.574	42.641	9.611
Years since migration	–	–	35.541	10.770	18.814	8.569	18.710	9.587
Year of arrival	–	–	1974	8.273	1984	11.921	1987	14.122
Experience with current firms	10.894	9.762	7.875	8.115	8.809	7.940	8.972	8.240
Good German language skills	–	–	0.988	0.106	0.624	0.484	0.777	0.416
Qualifications								
No vocational degrees	0.095		0.177		0.572		0.356	
Vocational degrees	0.739		0.671		0.335		0.475	
University degrees	0.166		0.152		0.093		0.169	
Establishment size								
Up to 10 workers	0.168		0.167		0.114		0.149	
Up to 20	0.132		0.112		0.099		0.107	
Up to 200	0.273		0.244		0.275		0.301	
Above 200	0.427		0.477		0.512		0.443	
Industry								
Agriculture	0.055		0.039		0.094		0.071	
Mining	0.148		0.185		0.303		0.238	
Manufacturing	0.084		0.118		0.141		0.124	
Construction	0.093		0.055		0.072		0.084	
Trade	0.149		0.172		0.152		0.142	
Transport and financial services	0.103		0.106		0.077		0.064	
Public administration	0.145		0.123		0.058		0.097	
Health and Education	0.178		0.163		0.081		0.145	
Private household	0.045		0.039		0.022		0.035	
Occupation								
Untrained/Semi-trained workers	0.138		0.207		0.649		0.476	
Trained workers	0.186		0.164		0.180		0.172	
Trained employees with simple tasks	0.089		0.102		0.027		0.063	
Qualified professionals	0.299		0.281		0.053		0.147	
Highly qualified professionals	0.189		0.171		0.040		0.087	
Civil servants	0.099		0.071		0.051		0.055	
Person–year observations	188,065		14,002		4,992		17,808	

Sample of individuals aged 18 to 64, having full-time or regular part-time employment

coming from countries with a low quality of schooling have only 9.967 years of quality-adjusted education, while the others from countries with a high quality of schooling have almost 16 years of quality-adjusted education. The reason is that many countries in Western Europe such as Denmark, Finland, Austria, France, and the United Kingdom as well as countries in East Asia such as Japan, Hong Kong, Singapore, China and Taiwan consistently have the highest ranking on the school quality index throughout the period from 1965 to 1991. This result is also reflected in the highest attained qualifications that they possess, i.e., vocational training and university graduation. For German natives, almost three-quarters have vocational degrees, and only 9.5

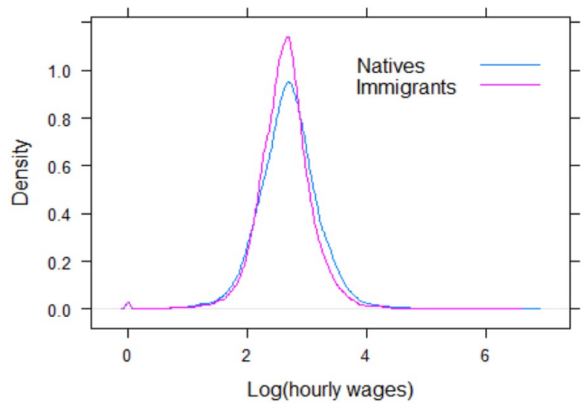

Fig. 3 Density functions of natives and immigrants (log) hourly wages. Kernel density wage estimation of natives and immigrants using Epanechnikov kernel function. Sources: SOEP (wave: 1984–2016), version 33, released in 2018

percent do not have school-leaving certificates. German-educated immigrants follow the same pattern in terms of education qualifications with 67.1 percent having vocational degrees, but the portion of people having no school-leaving certificates is remarkably higher at approximately 18 percent.

Despite having higher years of quality-adjusted education, immigrants from both groups in our sample are more likely to work in untrained or semi-trained occupations (39.79 percent), especially foreign-educated immigrants (64.9 percent), while natives are more likely to work in qualified professional occupations (29.9 percent), which, as we argue, explains part of the wage gap between natives and immigrants.

As mentioned previously, the data in the survey do not allow us to specifically determine the country where immigrants obtained their education. We therefore make the assumption that immigrants who migrated to Germany before the age of six acquire education exclusively in Germany (German-educated immigrants) and immigrants who migrated to Germany after the age of six either acquire education exclusively in their home countries or partly in Germany and partly in their home countries (foreign-educated immigrants) based on their age at migration and total years of education. Among these foreign-educated immigrants, approximately 31 percent already migrated to Germany when they were at least 18 years old, 63.69 percent did so when they were at least 25, and 80.80 percent did so when they were at least 30. If we assume that immigrants do not obtain any further tertiary education in Germany when they are older than 30 years old, there will be approximately 20 percent of foreign-educated immigrants who acquire their education exclusively outside Germany.

To shed light on the sub-sample of immigrants in our dataset, Table 2 presents some key statistics such as the school quality index, the mean birthyear, the mean years of (unadjusted) education and the mean year of arrival of immigrants from the top 20 sending countries. The total number of observations from these top 20 countries accounts for 91.46 percent of the total observations of the immigrants in our dataset (33,656 and 36,802, respectively). Most of these immigrants come from Europe, except for a quite substantial portion coming from Turkey (14.11 percent). In this sub-sample, Poland has the highest school quality index (64.37), and Turkey has the lowest school quality index (39.72). Recall that the Hanushek and Kimko (2000) school quality index is constructed based on the international standardized tests conducted between 1965 and 1991, and the range of mean birthyear of immigrants in the sample is from 1955 (Croatia) to 1972 (Kosovo-Albania and Ukraine); this strengthens our argument that the Hanushek and Kimko (2000) index is better than PISA or PIACC scores in capturing the time during which immigrants in the sample actually went to school.

In addition, immigrants from France have the highest average years of (unadjusted) education (13.22 years), compared to Italy with only 9.78 years. Among these immigrants, the largest proportion is those from Germany with almost 31 percent of the total observations. In other words, they are either first-generation immigrants who have already been naturalized or second-generation immigrants (born in Germany having at least one parent with a migration background). If immigrants indicate that Germany is their country of origin, they would not be asked about their year of arrival but instead be categorized in the group of "Born in Germany or immigrated before 1950". These immigrants also have the highest mean years since migration (35.54 years); on the other hand, immigrants from Eastern European countries such as Bulgaria, Romania and Ukraine migrated to Germany approximately 22 years ago, on average.

4 Empirical results

In this section, we first present our findings from the OLS regressions for the groups of natives and immigrants in the sample. Our interest is to see how years of education (after adjustment) affect immigrants' wages in Germany. Second, we present the results of the Oaxaca–Blinder decomposition model, in which we show that using quality-adjusted education yields a better understanding of the native–immigrant wage gap in Germany.

4.1 Returns to education: OLS estimation

Table 3 presents the OLS regression results for natives using unadjusted years of education. Column (1) presents

Table 2 Summary Statistics—Top 20 sending countries. Source: SOEP (wave: 1984–2016), version 33, released in 2018 and Hanushek and Kimko (2000)

Country of origin	Person–year observations	Percentage	School quality index	Mean birthyear	Mean years of education (unadjusted)	Mean year of arrival
Germany	11,397	30.970	55.740	1970	12.440	<1950
Turkey	5193	14.110	39.720	1963	9.880	1980
Italy	2687	7.300	49.410	1958	9.780	1976
Poland	2360	6.410	64.370	1969	11.900	1992
Kazakhstan	1954	5.310	54.650	1971	11.260	1995
Russia	1831	4.980	54.650	1969	11.680	1996
Greece	1524	4.140	50.880	1956	9.910	1975
Croatia*	1065	2.890	53.970	1955	10.230	1975
Romania*	1063	2.890	62.800	1971	12.020	1998
Bosnia–Herzegovina*	841	2.290	53.970	1958	10.040	1980
Spain	830	2.260	51.920	1958	10.120	1975
Kosovo-Albania*	506	1.370	51.280	1972	10.230	1992
Ex-Yugoslavia	465	1.260	53.970	1952	9.860	1975
Serbia*	441	1.200	53.970	1959	10.100	1979
Ukraine	312	0.850	54.650	1972	12.040	1998
Hungary	251	0.680	61.230	1966	13.180	1993
Bulgaria*	247	0.670	62.800	1968	12.030	1998
France	245	0.670	56.000	1964	13.220	1988
USA	235	0.640	46.770	1961	13.120	1983
United Kingdom	209	0.570	62.520	1961	12.710	1985

Sample of individuals aged 18 to 64, having full-time or regular part-time employment. *indicates six countries for which we do not have any information about their school quality index, namely, Croatia, Romania, Bosnia–Herzegovina, Kosovo–Albania, Serbia and Bulgaria with total observations of 4163, which accounts for 11 percent of full immigrant sample. We impute missing values based on geographical proximity. Ex-Yugoslavia consists of Bosnia–Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia; hence these countries take the school-quality index of the former Yugoslavia (i.e., 53.97). Romania and Bulgaria take the average value of Hungary and Poland (i.e., 62.80)

the results of the restricted model where we only control for years of education. Columns (2) and (3) gradually add other control variables, where we take into account all observable characteristics that determine wages. The results reveal that education has a positive and significant impact on earnings. In particular, one year of education is associated with an approximately 6.6 percentage point increase in hourly wages, *ceteris paribus*. Other variables such as experience, age, gender and marital status also show expected impacts on wages.

Table 4 presents the OLS regression results, first for all immigrants and then separately for German-educated and foreign-educated immigrants. For foreign-educated immigrants, we divide their total years of education into years of education abroad and years of education in Germany and adjust the years of foreign education using the Hanushek and Kimko (2000) school quality index. Table 4 only shows the results of our preferred models with all control variables. First, the conditional returns to education are positive and statistically significant. As expected, they are also lower than those of natives. For all immigrants, the return to one year of education is 5.3 percentage points (Column 2), which is lower than the 6.6 percentage points of natives. Second, when distinguishing between the German-educated and foreign-educated immigrant groups, we see that the return to each year of education for German-educated immigrants is approximately 6.2 percentage points, while the returns to each year of education for foreign-educated immigrants are significantly lower. In particular, each year of education in Germany is associated with a 2.6 percentage point increase in earnings, and each year of education outside Germany is associated with only a 1.4 percentage point increase in earnings, *ceteris paribus*. These results highlight the low transferability of human capital and the significantly low returns to foreign education. Furthermore, among immigrants, especially those who partly conducted their education outside Germany, are additionally punished in terms of wages, even when we take their quality of schooling in consideration.

Tables 3 and 4 strongly support the notion that there is a substantial gap in the returns to education between natives and immigrants. This gap is enlarged when we consider the school quality in immigrants' home countries.

Table 3 OLS—Estimated returns to education—Natives. Source: SOEP (wave: 1984–2016), version 33, released in 2018

Dep. Var: Log(hourly wages)	(1)	(2)	(3)
Years of education	0.067***	0.068***	0.066***
	(0.001)	(0.001)	(0.001)
Experience			0.019***
			(0.001)
(Experience-squared)/100			− 0.033***
			(0.002)
Male		0.210***	0.170***
		(0.005)	(0.005)
Age		0.040***	0.026***
		(0.001)	(0.001)
(Age–squared)/100		− 0.038***	− 0.027***
		(0.001)	(0.001)
Married			0.031***
			(0.005)
Constant	1.842***	0.811***	0.696***
	(0.015)	(0.030)	(0.031)
Person-year observations	188,065	188,065	188,065
R-squared	0.107	0.282	0.372

Dependent variable: Natural logarithm of hourly wages. Sample of natives aged 18 to 64, having full-time or regular part-time employment. Clustered robust standard errors at the individual level are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. In addition to the covariates shown in the table, models (2) and (3) control for federal state fixed effects and survey year fixed effects. Model (3) additionally controls for occupation, establishment size and industry fixed effects

Recall that on average, immigrants have higher adjusted years of education than natives, which means that the quality of schooling in their home countries must be higher than that in Germany. Hence, this result may first appear surprising because we should expect that given a higher quality of schooling, immigrants should receive higher rewards in terms of wages. To address this puzzling result, we examine the heterogeneity of effects across immigrants' country of origin. We argue that not only school quality but also the relative closeness to the German educational system matter for skill transferability. In doing so, we divide the country of origin of foreign-educated immigrants into five groups: OECD, Turkey, East Europe/former Soviet Union (FSU), Ex-Yugoslavia, and Others.[8] The results of the OLS regression for each group are presented in Table 5.

[8] OECD countries consist of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, the United Kingdom, Ireland, Israel, Italy, Japan, Benelux, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the Netherlands and the USA. East Europe/former Soviet Union consists of Russia, Ukraine, Belarus, Uzbekistan, Kazakhstan, Georgia, Lithuania, Azerbaijan, Moldavia, Latvia, Kyrgyzstan, Tajikistan, Armenia, Turkmenistan, Estonia, Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia. Ex-Yugoslavia consists of Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia.

Immigrants from the OECD and Eastern European/FSU countries have statistically significant returns to education. In particular, one additional year of education in an OECD country or in a Eastern European/FSU country is associated with a 2.2 percentage point and a 1.3 percentage point increase in the hourly wages in Germany, respectively. These results indicate that proximity of educational systems between immigrants' source country and Germany could partly explain the difference in the returns to education among different groups of immigrants. Our findings are in line with the empirical evidence on the impact of institutional and geographical proximity on economic growth improvement (Ahmad and Stephen 2012). In contrast, investment in education in Germany is associated with positive and significant returns across all country groups. In particular, immigrants from East Europe/FSU benefit the most (a 3.1 percentage point increase in hourly wages for each year of education in Germany), while the returns to education in Germany is the lowest for immigrants from Turkey (only 1.5 percentage point increase in hourly wages for each year of education in Germany).

Similar to Basilio et al. (2017), we also find that education in Germany yields higher returns than education abroad for all immigrant groups. This result holds true even for immigrants from high-income OECD countries where education systems, industrial structures and technology are comparable to those in Germany. Therefore, the quality of education in immigrants' home countries is important, but everyone could benefit from extra education in Germany. On the one hand, German employers are more familiar with the academic qualifications in Germany, and hence they reward German education more than foreign education. On the other hand, the knowledge, experience and language skills that immigrants receive during their education and training in Germany could also be more relevant for the German labour market than what they learned in their home countries. Not limited to using a similar approach to Basilio et al. (2017) in the heterogeneity analysis, our paper adjusts the quality of schooling in the home countries of immigrants to gain more plausible estimates of the returns to education. Additionally, our paper uses a more updated version of GSOEP (version 33) where the data span until 2016 (the former paper uses GSOEP data until 2013 only). With a wider span of data, we are able to include and analyse the inflow of new immigrants into Germany, especially after the surge of more than one million migrants and asylum seekers in 2015, which fundamentally changed the pool of immigrants in Germany (Eurostat 2018).

Table 4 OLS—Estimated returns to education—Immigrants. Source: SOEP (wave: 1984–2016), version 33, released in 2018

Dep. Var: Log(hourly wages)	All immigrants		German-educated immigrants		Foreign-educated immigrants	
	(1)	(2)	(3)	(4)	(5)	(6)
Years of education	0.057***	0.053***	0.060***	0.062***		
	(0.002)	(0.002)	(0.003)	(0.003)		
Years of education in Germany					0.023***	0.026***
					(0.004)	(0.003)
Years of education abroad (adjusted)					0.002	0.014***
					(0.002)	(0.003)
Experience		0.018***		0.020***		0.016***
		(0.002)		(0.003)		(0.002)
(Experience-squared)/100		− 0.030***		− 0.030***		− 0.029***
		(0.001)		(0.001)		(0.001)
Male	0.234***	0.199***	0.235***	0.177***	0.234***	0.217***
	(0.009)	(0.010)	(0.016)	(0.018)	(0.012)	(0.012)
Age	0.042***	0.026***	0.050***	0.039***	0.037***	0.015***
	(0.003)	(0.003)	(0.005)	(0.014)	(0.004)	(0.004)
(Age-squared)/100	− 0.043***	− 0.032***	− 0.051***	− 0.063***	− 0.038***	− 0.022***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Married		0.033***		0.023		0.030**
		(0.010)		(0.014)		(0.013)
Year since migration		0.002*		− 0.004		0.006***
		(0.001)		(0.014)		(0.002)
(Years since migration-squared)/100		0.002		0.002		−0.005
		(0.003)		(0.003)		(0.006)
Good German language skills		0.052***		0.075		0.081***
		(0.009)		(0.047)		(0.010)
Constant	0.948***	0.907***	0.675***	0.577***	1.515***	1.447***
	(0.056)	(0.059)	(0.098)	(0.111)	(0.078)	(0.076)
Person–year observations	36,802	36,802	14,002	14,002	22,800	22,800
R-squared	0.236	0.336	0.278	0.366	0.171	0.291

Dependent variable: Natural logarithm of hourly wages. Sample of immigrants aged 18 to 64, having full-time or regular part-time employment. Clustered robust standard errors at the individual level are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. In addition to the covariates shown in the table, all models control for federal state fixed effects, survey year fixed effects, and country of origin fixed effects. Models (2), (4) and (6) additionally control for occupation, establishment size and industry fixed effects

4.2 Native–immigrant wage gap: Oaxaca–blinder decomposition

In this section, we examine the contribution of school quality to the native–immigrant wage gap using the Oaxaca–Blinder decomposition method. Table 6 reports the results of this decomposition. Overall, the observed wage gap between natives and immigrants is − 5.1 log points. Existing studies have provided several reasons for this wage gap, such as lower returns to human capital obtained abroad, imperfect transferability of skills, and labour market discrimination that immigrants usually experience in the host country (Coulombe et al. 2014; Bartolucci 2014; Aldashev et al. 2012). The key feature of our approach is that we are able to examine the determining factor behind the lower returns to foreign education and the imperfect transferability of human capital of immigrants in the host country. More important, we show that lower school quality is one of the major reasons why immigrants earn significantly less than natives in Germany. In particular, when we adjust the years of education by the school quality measure, the share of the unexplained component of the native–immigrant wage gap declines (from − 0.183 to − 0.166 in the restricted model and from − 0.109 to − 0.087 in the unrestricted model). This decline in the unexplained component is equivalent to 9–20 percent. In other words,

Table 5 Heterogeneity analysis by regions of origin—Foreign-educated immigrants. Source: SOEP (wave: 1984–2016), version 33, released in 2018

Dep. Var: Log(hourly wages)	OECD	Turkey	East Europe/FSU	Ex-Yugoslavia	Others
Years of education in Germany	0.029***	0.015**	0.031***	0.017*	0.024**
	(0.008)	(0.007)	(0.005)	(0.009)	(0.012)
Years of education abroad (adjusted)	0.022**	0.007	0.013***	0.010	− 0.004
	(0.007)	(0.008)	(0.004)	(0.006)	(0.010)
Experience	0.012***	0.019***	0.021***	0.0087**	0.014**
	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
(Experience-squared)/100	− 0.017	− 0.039***	− 0.032***	− 0.015***	− 0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male	0.260***	0.251***	0.181***	0.222***	0.218***
	(0.026)	(0.025)	(0.019)	(0.030)	(0.051)
Age	0.016*	0.011	0.014**	0.021**	0.028*
	(0.009)	(0.008)	(0.006)	(0.009)	(0.015)
(Age-squared)/100	− 0.019	− 0.017**	− 0.023***	− 0.033***	− 0.027
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Married	0.028	0.048*	0.020	− 0.018	0.092**
	(0.027)	(0.027)	(0.019)	(0.031)	(0.042)
Year since migration	0.003	0.004	0.004	0.012*	−0.007
	(0.005)	(0.005)	(0.003)	(0.006)	(0.008)
(Years since migration-squared)/100	−0.009	0.005	0.014	− 0.003	− 0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Good German language skills	0.067***	0.056***	0.123***	−0.007	0.036
	(0.022)	(0.020)	(0.016)	(0.027)	(0.037)
Constant	1.415***	1.693***	1.171***	1.478***	1.491***
	(0.202)	(0.140)	(0.147)	(0.202)	(0.304)
Other controls	Yes	Yes	Yes	Yes	Yes
Person–year observations	5649	4158	8529	2707	1757
R-squared	0.300	0.351	0.292	0.238	0.404

Dependent variable: Natural logarithm of hourly wages. Sample of foreign-educated immigrants aged 18 to 64, having full-time or regular part-time employment. Clustered robust standard errors at the individual level are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. In addition to the covariates shown in the table, all models control for occupation, establishment size, industry fixed effects, federal state fixed effects, survey year fixed effects, and country of origin fixed effects

using quality-adjusted education we are able to account for differences in the unexplained part. This highlights the importance of differences in educational systems in explaining the native–immigrant wage gap and provides a rationale behind the unexplained component of decomposition methods, which is often referred to as "labour market discrimination" in the literature.

In general, immigrants receive lower returns to education than natives in the German labour market. These returns are further reduced if their education was obtained outside Germany. Similar to Coulombe et al. (2014), we find that a lower quality of education reduces the endowment advantage that immigrants earn during these years of education. We also observe that by controlling for quality-adjusted education, the wage gap between natives and immigrants widens, but the share of the unexplained component in this wage gap declines. This finding confirms the point made by Bonikowska et al. (2008) that what is frequently attributed to labour market discrimination may simply reflect the lower human capital quality of immigrants in comparison to natives.

5 Conclusions

In recent decades, the pattern of immigration has substantially shifted towards better skilled, mostly European immigrants in Germany (Dustmann et al. 2012). However, the wage assimilation of immigrants has progressed at a slow pace, leading to a substantial difference in earnings between immigrants and natives. The goal of this paper is to understand the determinants of the wage assimilation of immigrant workers and to what extent the international transferability of human capital explains their low initial earnings compared to natives.

Table 6 Oaxaca–Blinder Decomposition of immigrant wage gaps. Source: SOEP (wave: 1984–2016), version 33, released in 2018

	Unadjusted years of education		Adjusted years of education	
	Restricted model	**Unrestricted model**	**Restricted model**	**Unrestricted model**
Observed gap	−0.051***	−0.051***	−0.051***	−0.051***
	(0.007)	(0.005)	(0.007)	(0.005)
Explained gap				
Education	−0.070***	−0.072***	−0.073***	−0.074***
	(0.003)	(0.003)	(0.004)	(0.003)
Experience		−0.049***		−0.049***
		(0.003)		(0.003)
Experience-squared		0.025***		0.025***
		(0.002)		(0.002)
Male		0.007***		0.007***
		(0.001)		(0.001)
Married		0.002***		0.002***
		(0.000)		(0.000)
Age		−0.064***		−0.064***
		(0.005)		(0.005)
(Age-squared)/100		0.061***		0.061***
		(0.005)		(0.005)
Year since migration		−0.043***		−0.043***
		(0.015)		(0.015)
(Years since migration-squared)/100		0.006		0.006
		(0.015)		(0.015)
Good German language skills		−0.007***		−0.007***
		(0.001)		(0.001)
Unexplained gap				
Education	−0.183***	−0.109***	−0.166***	−0.087***
	(0.033)	(0.027)	(0.033)	(0.029)
Experience		−0.013		−0.015
		(0.015)		(0.015)
Experience-squared		0.007		0.007
		(0.009)		(0.009)
Male		0.004		0.007
		(0.006)		(0.006)
Married		0.005		0.006
		(0.007)		(0.008)
Age		0.006		0.023
		(0.128)		(0.128)
(Age-squared)/100		−0.061		−0.058
		(0.069)		(0.070)
Year since migration		0.136***		0.120***
		(0.042)		(0.042)
(Years since migration-squared)/100		−0.026		−0.022
		(0.031)		(0.031)
Good German language skills		0.062***		0.056***
		(0.010)		(0.010)

Sample of individuals aged 18 to 64, having full-time or regular part-time employment. Clustered robust standard errors at the individual level are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively. In addition to the covariates shown in the table, columns (2) and (4) also control for occupation, establishment size, industry fixed effects, federal state fixed effects, survey year fixed effects, and country of origin fixed effects

Understanding the determinants of the native–immigrant wage gap has important policy implications for at least two reasons. First, slow wage assimilation rates may have adverse impacts on the long-term integration process of immigrants by inducing adverse incentives regarding human capital investment by immigrants in the host country. Second, a large wage gap between immigrants and natives may also reflect significant labour market barriers for immigrants in the host country.

We propose an empirical strategy that accounts for the quality of schooling in immigrants' source countries. Our empirical findings highlight several new insights. First, the quality of the schooling system is an important predictor of the speed of wage assimilation for immigrants. We show that the earnings of immigrants who obtained their education in countries with high-quality schooling systems catch up about eight years faster to natives than immigrants who received their education in countries with low-quality schooling systems.

Second, our findings indicate that one potential reason for the low international transferability of human capital may be driving by the poor quality of school systems in immigrants' home countries. On average, the return to education for foreign-educated immigrants is approximately 3.6 percentage points lower compared than the returns to education of German-educated immigrants (2.6 and 6.2 percentage points, respectively). However, when accounting for school quality, the return to foreign education decreases further to 1.4 percentage points. These results indicate that further educational investment in the host country yields significant returns for immigrants.

Third, using the Oaxaca–Blinder decomposition method, our empirical findings reveal that the school quality index explains a remarkable part of the unexplained component of the native–immigrant wage gap decomposition: school-quality-adjusted foreign education reduces the unexplained component by approximately 20 percent. This finding highlights that school quality in the home country of immigrants can substantially explain differences in unobservables.

To summarize, our findings highlight that the integration of immigrants into the host society depends largely on institutional features and educational policy in their home countries. Particularly, the quality of schooling in their home countries is a strong predictor of their performance in the host country's labour market. Furthermore, our analysis shows that there is substantial heterogeneity in the quality of schooling across immigrants' home countries. Taking these heterogeneities into consideration improves our knowledge about the determinants of the wage assimilation of immigrants and why they initially earn less than natives.

Acknowledgements
We would like to thank Silke Anger, Elizabeth Cascio, Bob Hart, Stephen Machin and participants in the International Workshop on Applied Economics of Education 2017 in Catanzaro and the VII Workshop on Economics of Education in 2017 in Barcelona and especially two anonymous reviewers for helpful comments and suggestions. Huy Le Quang also gratefully acknowledges the financial support from the Graduate School (GradAB) at the Institute for Employment Research. All remaining errors are our own. The views, opinions, findings and conclusions expressed in this article are strictly those of the authors.

Author contributions
We equally contributed to completing this research. In particular, HLQ was responsible for idea generation, data cleaning, data analysis and paper drafting, and EV was responsible for defining the scope of study, proofreading and editing the last version of the paper. Both authors read and approved the final manuscript.

Funding
We did not receive any funding specifically related to this research.

Availability of data and materials
The datasets used during the current study are available from the corresponding author on reasonable request.

Declarations

Consent for publication
We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere. We declare that all authors have approved the manuscript for submission.

Competing interests
We have no conflicts of interest.

Author details
[1]Otto–Friedrich University of Bamberg, Bamberg, Germany. [2]Institute for Employment Research (IAB), Nuremberg, Germany.

Received: 24 June 2021 Accepted: 21 June 2022
Published online: 08 July 2022

References

Ahmad, M., Stephen, G.H.: Economic growth and convergence: Do institutional proximity and spillovers matter? J. Policy Model **39**(6), 1065–1085 (2017)
Aldashev, A., Gernandt, J., Thomsen, S.L.: The immigrant-native wage gap in Germany. J. Econ. Stat. **232**(5), 490–517 (2012)
Aleksynska, M., Tritah, A.: Occupation-education mismatch of immigrant workers in Europe: Context and policies. Econ. Educ. Rev. **36**, 229–244 (2013)
Amann, R.A., Klein, T.J.: Returns to type or tenure? Journal of the Royal Statistical Society. Seri. A Stat. Soc. **175**(1), 153–166 (2012)
Bartolucci, C.: Understanding the native-immigrant wage gap using matched employer employee data: Evidence from Germany. ILR Rev. **67**(4), 1166–1202 (2014)
Basilio, L., Bauer, T.K., Kramer, A.: Transferability of human capital and immigrant assimilation: An analysis for Germany. Labour **31**(3), 245–264 (2017)
Betts, J.R., Lofstrom, M.: The educational attainment of immigrants: Trends and implications. NBER Chapters, in: Issues in the Economics of Immigration, 51–116 (2000)
Blinder, A.S.: Wage discrimination: Reduced form and structural estimates. J. Hum. Resour. **8**(4), 436–455 (1973)
Bonikowska, A., Green, D.A., Riddell, W.C.: Literacy and the Labour Market: Cognitive Skills and Immigrant Earnings. Statistics Canada Ottawa, Canada (2008)
Bratsberg, B., Ragan, J.F., Jr.: The impact of host-country schooling on earnings: A study of male immigrants in the United States. J. Hum. Resour. **37**(1), 63–105 (2002)

Bratsberg, B., Terrell, D.: School quality and returns to education of US immigrants. Econ. Inq. **40**(2), 177–198 (2002)
Bundesministerium für Bildung und Forschung: Weiterbildungsverhalten in Deutschland 2018. Ergebnisse des Adult Education Survey, AES-Trendbericht (2019)
Burdett, K.: A theory of employee job search and quit rates. Am. Econ. Rev **68**, 212–220 (1978)
Card, D., Krueger, A.B.: Does school quality matter? Returns to education and the characteristics of public schools in the United States. J. Polit. Econ. **100**(1), 1–40 (1992)
Chiswick, B.R., Miller, P.W.: Why is the payoff to schooling smaller for immigrants? Labour Econ. **15**(6), 1317–1340 (2008)
Chiswick, B.R., Miller, P.W.: The international transferability of immigrants' human capital. Econ. Educ. Rev. **28**(2), 162–169 (2009)
Chiswick, B.R., Miller, P.W.: The effects of school quality in the origin on the payoff to schooling for immigrants. Migration and Culture, 67–103 (2010)
Coulombe, S., Grenier, G., Nadeau, S.: Human capital quality and the immigrant wage gap. IZA J. Migr. **3**(1), 14 (2014)
de Oliveira, M.M., Santos, M.C., Kiker, B.F.: The role of human capital and technological change in overeducation. Econ. Educ. Rev. **19**(2), 199–206 (2000)
Dustmann, C., Frattini, T., Lanzara, G.: Educational achievement of second-generation immigrants: An international comparison. Econ. Policy **27**(69), 143–185 (2012)
Eurostat: Einwanderung Nach Alter und Geschlecht. http://ec.europa.eu/eurostat/de/data/database Accessed 2022-05-12
Fortin, N., Lemieux, T., Torres, J.: Foreign human capital and the earnings gap between immigrants and Canadian-born workers. Labour Econ. **41**, 104–119 (2016)
Friedberg, R.M.: You can't take it with you? Immigrant assimilation and the portability of human capital. J. Labour Econ. **18**(2), 221–251 (2000)
Hanushek, E.A.: The economics of school quality. German Econ. Rev. **6**(3), 269–286 (2005)
Hanushek, E.A., Kimko, D.D.: Schooling, labour-force quality, and the growth of nations. Am. Econ. Rev. **90**(5), 1184–1208 (2000)
Hill, P.W., Rowe, K.J.: Multilevel modelling in school effectiveness research. Sch. Eff. Sch. Improv. **7**(1), 1–34 (1996)
Jovanovic, B.: Job matching and the theory of turnover. J. Polit. Econ. **87**(5), 972–990 (1979)
Michaelowa, K.: The impact of primary and secondary education on higher education quality. Qual. Assur. Educ. **15**(2), 215–236 (2007)
Muysken, J., Vallizadeh, E., Ziesemer, T.: Migration, unemployment, and skill downgrading. Scand. J. Econ. **117**(2), 403–451 (2015)
Oaxaca, R.: Male-female wage differentials in urban labour markets. Int. Econ. Rev. **14**(3), 693–709 (1973)
OECD: Program for International Student Assessment. https://www.oecd.org/pisa/. Accessed 12 May 2022
OECD: Program for the International Assessment of Adult Competencies. https://www.oecd.org/skills/piaac/ Accessed 12 May 2022
Raaum, O.: Returns to education and Norwegian language skills among immigrants in Norway. SNF-Oslo, Oslo (1998)
Rohrbach-Schmidt, D., Tiemann, M.: Limited transferability of human capital across countries–the case of workers with foreign qualifications in Germany. Federal Institute for Vocational Education and Training Discussion Paper (2016)
Sweetman, A.: Immigrant source country educational quality and Canadian labour market outcomes. Analytical Studies, Statistics Canada (2004)
Wagner, G.G., Frick, J.R., Schupp, J.: The German Socio-Economic Panel Study (SOEP): Scope, Evolution and Enhancements. Schmollers Jahrbuch : Journal of Applied Social Science Studies / Zeitschrift für Wirtschafts- und Sozialwissenschaften **127**(1), 139–169 (2007)
Wößmann, L.: Specifying human capital. J. Econ. Surv. **17**(3), 239–270 (2003)

Publisher's Note