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When we worked on the first draft of this paper, the current situation of high numbers of refugees coming to Germany was not foreseeable. It is important to stress that the analyses in this paper are not concerned with these very recent immigrant populations. As far as it is known, these refugees are – on average – less qualified than the (former) migrant population in Germany and of very young age (cf. Brücker et al. 2015). We are aware, though, that recent developments make our main question of skill-utilisation among workers with either a migrant background or foreign qualifications more pressing.

Germany has built a tradition of work immigration, with different immigration phases and different populations of immigrants.[1] Not just against the backdrop of demographic changes and a rising demand for highly skilled workers, the integration of immigrants into the German labour market is of high importance. Yet, studies for several countries show that immigrants face the risk that their human capital acquired in their countries of origin is not transferable to the host country, and thus, that immigrants face higher risks of being employed in jobs for which they are formally over-qualified. This is not an optimal situation for the affected individuals and firms, and the literature repeatedly shows that mismatching typically comes in conjunction with wage penalties or job dissatisfaction.

Some findings give reason to assume that a waste of immigrants' talents is present in the German labour market. For example, in 2014, the Directorate General for Justice commissioned a case study (EU 2014) on the impact and scale of working mobility in the European Union[2] within six European cities, one of which was the German city of Hamburg. It was found that, between 2004 and 2011, 2 to 9 percent of the cities' total populations were EU mobile citizens. Those at working age take up work "at the extremes of the skills spectrum. EU mobile citizens tend to cover low-skilled occupations, which can be considered less attractive for native employees and where the mismatching between nationals' qualifications and demand for low-skilled labour is likely to be more significant, as well as more high-skilled occupations" (EU 2014, p. 4).[3] All in all, EU mobile workers tend to be younger than their native counterparts (EU 2014,

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[1] Beginning with the end of the 1950s, foreign workers were invited into the country. They performed work, work tasks and low-skill jobs that were less attractive to native workers. Those "guest workers" came from southern Europe and beyond (e.g. Italy, Greece, Turkey, and Yugoslavia). They and their children could only become German citizens upon fulfilling a number of conditions. These people are among the first we today define as having a migrant background. Although guest workers were not recruited on that large a scale after the 1960s, the situation of immigrants did not change much. They were not granted citizenship, and labour-market entry was fairly restricted. Thus, low-skilled work was common among immigrants and guest workers. In 2005, a law on immigration was passed which allowed for some changes. Yet, immigration was still restricted, and it was mostly high-skilled and highly qualified workers that were sought. Immigrants had to prove (to the Federal Employment Agency) they had a work contract and that they had suitable qualifications. With the dooming skill shortages, some programs were launched to additionally attract high-skilled immigrants. In these "Blue-Card" and "Green-Card" programs, the aim was specifically to get high-qualified persons with specific qualifications (like IT-specialists) to come to work and live in Germany. Besides this, immigration policies continued to demand from prospective immigrants' proof of their prospective employer and work contract (or, for self-employed: proof of the economic feasibility of their endeavour).

[2] Within the European Union, the "Directive 2004/38/EC on the right of Citizens of the Union and their family members to move and reside freely within the territory of the Member States" grants a right to working mobility.

[3] While on the political level the study calls for better mechanisms of inclusion, on the economic level, this kind of working mobility is not seen as problematic: "The results of the study confirm that internal EU mobility can bring some benefits in terms of economic output of the host communities, whereas negative economic impacts are clearly excluded" (ibid.).

p. 157). They tend to be formally more highly educated (EU 2014, p. 159), to yield worse labour market outcomes (work in low- or medium-skilled and manual occupations that are less attractive to native employees) (EU 2014, p. 158), and are more likely to be over-qualified (EU 2014, p. 160): "With an over qualification rate around 29 %, foreign-born EU mobile citizens are clearly more likely to be overqualified than native-born persons, who registered a rate of only 19 %". Regarding this, the study comments: "On the whole, this trend could imply a wasting of skills and hinder the potential benefits and impacts of intra-EU mobility" (EU 2014, p. 160). Similarly, Biavaschi and Zimmermann (2014) state that migration from "Eastern Partnership countries", especially from the Ukraine, [is] thought to hold a key in supplying skills needed (in the medium term) in the German labour market. Descriptive figures would show that migration from these countries "has progressively become a female phenomenon" (p. 4), with tertiary education certificates being much more likely than with natives, and female migrants being more likely than female natives to hold an engineering degree (p. 17). Yet: "The educational advantage does not translate into better labour market outcomes" (p. 9), and "these migrants currently do not appear to find a job that matches their skills" (p. 17). Moreover, "they exhibit particularly high levels of over-qualification and unemployment rates for the tertiary educated" (ibid).

From a cross-national comparative perspective, the question of limited transferability of human capital is of particular relevance in the German context. The German skill system is characterised by high degrees of standardisation and stratification, and is strongly specifically oriented. Verhaest/Van der Velden (2013) present evidence that countries with specifically-oriented programs are particularly successful in providing an entry ticket into the labour market and in rising the probability of a good match in the first job, but that they are less successful in enhancing the transition from over-education to a good match. Similarly, Di Stasio et al. (2015) show, in a recent cross-national comparative study of over-education, that the incidence of over-education is lower in countries with a strong vocational orientation.

It thus follows that immigrants in general, but especially those from countries with a general orientation of their educational programmes, might particularly have problems in transferring their human capital to Germany. In 2012, the German Federal Recognition Act was enacted to make the recognition processes for foreign qualifications easier and faster. At its core, it seeks to build structures in which people seeking recognition can find the relevant authorities to process their requests. Still, recognition strongly relies on the institutionalised context of the German labour market, as it is mandatory to name a reference (or "destination") occupation. Bearing in mind that some occupations trained in the German Dual System follow from academic trainings in other countries, this will not necessarily help to decrease formal over-qualification.

One could argue that a missing correspondence between a job holder's formal education and the educational requirements of his or her job, however, would be a lesser problem of wasting of human capital if individuals could nevertheless use (most of) their skills. Lacking information on skill utilisation in most surveys restricts most findings to educational mismatching. The few studies observing skill utilisation consistently find that, in fact, individuals can be mismatched in terms of their education, even though their skills or abilities are in fact appropriate for the jobs that they do (Green/McIntosh 2007; Rohrbach/Tiemann 2016).

To our knowledge, no study has applied the issue of skill utilisation to the debate on the limited transferability of human capital across countries (but see McGuinness/Byrne 2014 for skill mismatching of immigrants that graduated in the host country). Our paper aims to provide such a contribution. We use the recent data of the BIBB/BAuA Employment Survey 2012, which is a representative labour force cross-section on qualification and working conditions in Germany. In contrast to most other surveys, it allows for observing the level of both educational and skill mismatch among workers with (all their) formal qualifications attained outside Germany. We thereby focus on a sample of immigrant workers that is comparatively highly qualified, and thus

respresents a selective group of immigrants in Germany. In contrast to immigrants with few or no German language abilities—who often do not participate in the labour market, and where a specific need for action is given—the analyses aim at providing insights into labour market integration for workers with relevant human capital attained abroad, focusing on questions centred around brain waste or brain drain.

The paper is organised as follows: in the following section, we present relevant theoretical frameworks from which we derive some hypotheses on the incidence of over-education and over-skilling among immigrants in Germany. This is followed by an introduction to the data used and the outline of our empirical approach. Section 4 presents the results. Central findings are summarised in the last section.

2   Theoretical frameworks and hypotheses

2.1   Human capital and search theory

For classical human capital theory (HCT), (persistently) large shares of mismatched employees is a challenging matter. Within HCT, substantial mismatching should not exist. It would be a temporary phenomenon (Sichermann/Galor 1990) or a result of unobserved worker heterogeneity (by measurement error or missing controls, such as abilities or skills in wage equations—*e.g.* see Green/McIntosh (2007)). This would mean that mismatching is either the result of a human capital investment strategy (Chevalier 2003), or that workers are factually placed in appropriate jobs according to their skills—i.e. over-educated workers would in fact be less able than others with similar qualifications (and vice versa).

Applied to immigrants' over-qualification, an important aspect is how transferable their human capital is. The literature mainly discusses differences in schooling quality and the comparability of the human capital (education and labour market experience) attained abroad, considering the host country's labour market requirements and differences (Friedberg 2000). From the perspective of human capital theory, immigrants have to trade-off between their levels of qualification and experience and—at the time of their arrival—may take jobs below their qualification levels to gain experience in the host country's labour market. Also, as one year of schooling might effectively equate to more or less than a year of schooling in different countries, workers might seem to be over-educated (or under-educated) when in fact they are correctly matched. In addition, because of the lower schooling quality, immigrants from less-developed countries are more likely to sort into jobs where natives have formal qualifications that are below those of immigrants. From both perspectives, over-education should decrease over time, as immigrants move to better jobs and learn the language of the host country, such that their schooling might then be seen as more comparable. Under-education might also occur among immigrants, e. g., if they are highly motivated and seek jobs with higher requirements. This kind of under-education will not decrease over time, since, in the trade-off, they will find their job-experience recognised (Chiswick/Miller 2009, p. 163).

Instead of real human capital differences, search and match theories see differences in match categories as a temporary phenomenon resulting from imperfect information on both sides—immigrant job-seekers and native employers. Individuals, themselves, do not know what the job actually requires, and firms do not know exactly what the applicant's certificate means. These imperfections become more intense for immigrants "from countries with labour markets and institutions that differ appreciably from those of the destination country" (ibid., p. 163). Worker experience helps diminish these imperfections in information, as the worker gets to know the requirements of the specific job and of other jobs in the destination country, and employers get to know the actual abilities of the immigrant workers. Over time, mismatch (i. e., over-education) should decline. Under-education would only occur if relevant information about the destination countries' labour market are known by immigrant workers and they follow a wealth-maximising (ibid., p. 163) strategy, seeking jobs with higher formal qualification requirements than they have. There should be no differences between native and immigrant job seekers in this scenario, and under-education should actually increase with time on the labour market.

Several studies without a focus on immigration suggest that unobserved worker heterogeneity has a relevant share in explaining differences between match categories (Allen/van der Velden 2001; Bauer 2002; Chevalier 2003; Frenette 2004; Green 2006; Green/McIntosh

2007); on the contrary, Hartog/Jonker (1996) report a weak positive correlation between un-der-education and childhood IQ, and Korpi/Tåhlin (2009) do not find strong support for the 'human capital compensation hypothesis' with panel data from Sweden. Altorjai (2013) finds evidence for higher probabilities of over-qualification for immigrants, and that, with age and time on the labour market, this probability declines (consistent with HCT and findings by Battu/Sloane 2004).[4] To our knowledge, Chiswick/Miller (2009) is the only study on immi-grant over-qualification that includes some measures of skill heterogeneity. They consistently find that, due to less than perfect transferability of skills across countries, immigrants experience poorer job matches. With time spent on the labour market of the destination country, the prob-ability of being over-educated declines, while that of being under-educated rises. They find evidence for "uncertainties on the part of US employers over the value of skills acquired on the job in foreign countries" (ibid.) due to pre-immigration labour market experiences, leading to higher probabilities of being over-educated. Nonetheless, the study does not include skill utilisa-tion.

Against this background and from both HCT and search theory, the following hypotheses can be derived:

H1a: *The incidence of over-education should be higher among immigrants than among natives*

H1b: *The difference in the incidence of over-education between immigrants and natives should de-cline once skill differences between individuals are controlled for (skill utilisation, German language skills, state of health)*

H2a: *The incidence of over-skilling should not be higher among immigrants than among natives once skill differences between individuals are controlled for (in addition to education: Ger-man language skills, state of health)*

H3a: *The incidence of over-education and over-skilling among immigrants should diminish with time in the labour market.*

2.2   Institutional approaches and signalling

As they see mismatch as a real phenomenon, institutional approaches and signalling theory dif-fer from HCT and search theory as workers can actually be in jobs for wich they are over- or under-qualified. Job competition models emphasise another aspect, since individuals' positions in the job queue are seen here as determined by the signals regarding the persons trainability, through his or her schooling and experience (Kalleberg 1996; Sørensen/Kalleberg 1981; Spence 1973).

Then, as Chiswick/Miller (2009) note, there should be little mismatching among natives in their first jobs[5], but risk-averse employers might be unclear about the human capital signaled by immigrants, such that over-qualification might be particularly high at the time of arrival. This might especially be the case in Germany, where individuals with occupationally-specific creden-tials are favoured for access to many occupational positions. This leads to particularly good

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[4] Moreover, she finds interesting results regarding immigration policies. In the UK, these are temporarily ordered and have independent influences on the probability of being over-qualified—i.e., they always increase this probability (p. 27). However, the effect of policies is outside the scope of the current paper.
[5] Some recent papers discuss education as a positional good that drives up overinvestment in education in spe-cific institutional contexts or labour market segments, where over-education is a strategy to maintain one's po-sition in the labour queue (see quotes in Di Stasio et al. 2015). Though this process might be at work here as well, we think that this mechanism is not especially prevalent among the immigrant sample that we survey in our data. Rather, this applies to very competitive settings that set high incentives to acquire more education than is usually required for a given job.

matches in the first job, but, at the same time, to a high persistence of over-qualification in Germany. The cross-national comparative study of VERHAUST/VAN DER VELDEN (2013) finds evidence in favour of these assumptions. Following these arguments, it can be derived that: over-education is more pervasive among immigrants (in accordance with H1a); but that it is not merely a short-term phenomenon or the result of unobserved heterogeneity (immigrants are in fact less able/less appropriately skilled for the German labour market)—rather, that there are institutional barriers that hinder immigrants to (fully) utilise their skills. Besides these institutional barriers (and imperfect information), discrimination might also play a role. Moreover, over-qualification from this perspective should not necessarily diminish with time in the labour market, because immigrants initially employed in mismatched positions might have difficulties in promotion due to barriers in internal labour markets, credentialism and occupational closure. In particular, this should hold for immigrants that (so far) have not attained further qualifications in Germany.

Thus, following alternative hypotheses can be formulated.

H1c: *The difference in the incidence of over-education between immigrants and natives should not decline once skill differences between individuals are controlled for (skill utilisation, German language skills, state of health)*

H2b: *The incidence of over-skilling should be higher among immigrants than among natives, even if skill differences between individuals are controlled for (in addition to education: German language skills, state of health)*

H3b: *The incidence of over-education and over-skilling among immigrants should not (completely) diminish with time in the labour market (only institutional approach).*

3 Empirical Approach

The sample used to test these hypotheses is from the 2012 wave of the BIBB/BAuA Employment Survey, which is a representative employment cross-section on qualification and working conditions in Germany. It includes information on respondents' qualifications and career histories, as well as on detailed job-related information (organisational information, job tasks, job skill requirements, working conditions, health etc.). The data set is available for scientific research at the Research Data Centre of the Federal Institute for Vocational Education and Training at http://bibb-fdz.de. The data set is cross-sectional by design. One of its main strengths is its large sample size of 20,036. The study population comprises persons belonging to the labour force (*i.e.* having a paid work), age 15 and over, with a regular working time of at least ten hours per week ("core employment population"). The data were collected in CATI interviews in the German language, and thus, it should be recognised that the study population represents a (positively selected) group of employed individuals with sufficient language skills.

As in other studies[6], there is no variable that directly surveys whether the respondent is an immigrant. We use information on two measures to indirectly define our study samples. The first measure (immigrant definition 1) focuses on the aspect of the limited transferability of human capital. It indicates whether the respondent has achieved one[7] of his or her vocational degrees[8] in a foreign country ($n_{unweighted} = 699$). This equals around 2,062,000[9] workers, which represents around 5.8 % of the core employment population. While the focus is on the transferability, by this approach, German individuals who studied abroad or attained a vocational degree (e. g. in a high-income country other than Germany) also fall into this group. Because these individuals are not necessarily a part of the focus of our study, we further restrict the sample to those individuals who achieved *all* their vocational degrees in a foreign country as a second definition (immigrant definition 2, $n_{unweighted} = 468$, around 1.5 million). An alternative approach for restricting the sample to foreigners is to use information on the migrant status—i. e. whether or not at least one of the first languages learnt is German. Thus, we categorise individuals for which both conditions apply—at least one foreign degree and German not one of the first languages—as a third immigrant definition. 382 individuals fall into this group (around 1.3 million). Caution is advised in interpreting these measures. The groups defined in these ways should be thought of as those very likely to be immigrants.

By definition, individuals without any vocational degree are underrepresented in the immigrant samples, in that, for these individuals it cannot be identified whether they failed to achieve

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[6] Very recently, a panel study of around 5,000 individuals with migrant backgrounds was set up (see Brücker et al. 2014). This study explicitly aims at surveying the educational and work pathways of different groups of (im)migrants in Germany. A first round of the data is available for scientific research as of the end of 2014. In contrast to the data here, as far as we are aware, no information on skill utilisation has been collected.

[7] The data include the time span for each educational program attained. In a later version of the paper, we will use this information to distinguish between migrants who attained their latest degree in a foreign country or in Germany.

[8] Alternatively, an even more reliable definition would restrict the sample to those with foreign vocational education and the highest schooling degree attained in a foreign country. However, respondents were not explicitly asked whether their schooling degree was attained in a foreign country, but only to state their highest schooling degree; interviewers then assigned them to the German degrees and only to the category, "foreign degree", if there was no correspondence with other categories. Consequently, the sample of individuals with foreign schooling and all vocational education attained abroad is very small (nunweighted = 82) and probably a selective subsample of the total group.

[9] For a 95 % confidence interval the true value lies between 1,951,260 and 2,179,656.

a degree in Germany or abroad. For this reason, individuals without a vocational education are dropped from the total sample (n = 1,384). Excluding them results in only minor reductions of our immigrant samples (n_{def_1} = 690, n_{def_2} = 456, n_{def_3} = 376). This inevitable restriction, however, leads to an underrepresentation of under-educated workers in our study.

Whereas most studies rely on over-education alone, the data used here allow for observing both educational and skill mismatch based on a subjective approach. This subjective method has several strengths over 'objective measures' based on occupational classifications (e. g. using information from realised matches) or expert ratings of occupational skill requirements. Most importantly, the latter run the risk of conflating supply and demand, not capturing within-occupational heterogeneity, and being less current (see McGuinness 2006 and Hartog 2000 for good overviews of advantages and drawbacks of different measures).

Our measurement of (mis)matching is explained in detail in Rohrbach-Schmidt/Tiemann (2016). Information on workers' vocational educational attainments (above compulsory general education) and the educational requirements of their respective jobs[10] is used to measure *educational* (mis)matching. The ordinal (from lowest to highest) categories range from no qualification, to dual/school-based training and advanced training, and to academic education qualifications (see appendix Table I for educational qualifications summarised in these categories). For instance, over-qualified individuals are respondents with advanced training or academic education as their highest attainment, who are employed in jobs that require a dual/school-based training. Because we dropped individuals without any vocational degree from our sample, the group of under-educated workers only includes workers with dual/school based training or advanced training.

Reflecting the degree of accordance between workers' skills and knowledge and their respective jobs' requirements, we measure *skill mismatching* with a subjective assessment of whether respondents generally feel that they are up to, overstrained or under-challenged by the requirements of their current job with regard to their skills. We combine the information from both mismatching-types in one variable, decomposing over- and under-qualification into three categories each (see Green/Zhu (2010) for a similar approach).

Then, real over-qualification is defined as being over-educated and over-skilled, whereas over-education occurs if the worker is only formally over-qualified (but not over-skilled), and a worker is over-skilled only if the worker is over-skilled but not over-educated. The same holds for under-education–and underskilling. Hence, matched workers are only those who are neither over- or under-educated, nor over- or under-skilled[11].

In our models, we consider the *socio-demographic variables* of age, gender, marital status and children living in the household. Standard *human capital variables* considered are: highest vocational degree (and virtual years of education[12]); labour market experience in years (interview year minus years of employment gaps, minus year of first employment); and tenure (years of

[10] Respondents were asked 'what kind of qualification usually is required to do your job as a <current main job>?'.

[11] Please note that our decomposition consists of intersections: with three categories for each mismatching–measure, there are technically nine distinct groups. But, for example, someone who is over–skilled and matched according to his or her formal qualification will still be counted as over–skilled and hence mismatched. So the share of matched workers in the decomposed measure is much lower than in both singular measures. Also, the shares of those being formally undereducated and under–skilled sum up to a higher value than the share of those being undereducated in the decomposed measure, because someone being educationally under–qualified might still feel under–challenged (over–skilled).

[12] Virtual years of education were computed by adding up the time it usually takes to achieve a certain degree. For example, to achieve a bachelor's degree, one would typically have attended general school for 13 years, of which nine are in secondary education, plus three years at a university. In sum, such a person would get a score of 16 years for virtual education.

employment with the current employer) .[13] Unfortunately, in our data, we cannot differentiate between pre- and post-immigration labour market experience. This is an important restriction, and thus, strictly speaking, hypotheses H3a and H3b (on the interaction of immigration status and labour market experience) cannot be reliably tested. If no substantially large and statistically significant effects were to appear, then this could simply result from the loose measurement of German labour market experience. In the case of tenure, we only consider employers with a presence in Germany (and we thus drop 85 cases from the total sample). In order to capture differences in productive capacity (skill levels/use), we also consider the level of German language skills required at the job (no, basic, advanced/professional skills) and the state of health (from poor (1) to excellent/perfect (5)). Table 1 gives a description and summary statistic of selected variables.

Most remarkably, the immigrant samples differ from the total sample in their much higher proportions of university graduates. This difference is not surprising, as the German skill system —in contrast to most other countries, which focus on academic education—is strongly vocationally oriented. Large fractions of the working population (around 60 percent) have a vocational degree from the upper-secondary level as their highest degree, and most of them attained it

Table 1
Summary statistics

	Full sample	Immigrant sample def. 1: individuals with one foreign voc. educ. degree)	Immigrant sample def. 2: individuals with all their voc. educ. attained abroad)	Immigrant sample def. 3: individuals with one foreign voc. educ. degree & first language not German
Gender (% Males)	.56	.61	.64	.61
Age	43.3 (11.3)	45.5 (10.3)	45.7 (10.0)	45.0 (10.1)
Working hours per week	39.5 (12.0)	39.5 (12.7)	39.8 (13.0)	39.4 (13.2)
No vocational degree	dropped	dropped	dropped	dropped
Dual/school–based training	65.3	46.7	53.3	42.2
Advanced training	8.4	3.7	2.4	4.1
University degree	26.4	49.6	44.3	53.7
Education (virtual years)	13.5 (2.47)	14.0 (2.61)	13.7 (2.60)	14.0 (2.60)
Experience (in yrs.)	21.4 (11.3)	22.1 (11.5)	22.8 (11.1)	21.2 (11.4)
Tenure (in yrs.)	12.2 (10.6)	10.9 (9.3)	11.4 (9.4)	10.4 (9.1)
Hourly Wages (in Euro)	17.4 (14.8)	19.2 (19.1)	18.5 (13.7)	18.2 (14.7)
No Germ. lang. skills req.	8.8	12.3	14.4	12.0
Basic skills required	45.3	43.0	45.5	48.8
Expert skill required	46.0	44.7	40.1	39.3
Health	3.3 (0.85)	3.3 (0.93)	3.3 (0.92)	3.2 (0.94)
No. of cases (max.)	18,606	690	456	376

Source: BIBB/BAuA Employment Survey 2012, weighted values, own calculations.

within the 'dual system'—a (generally) three-year apprenticeship training with part-time work-place training in firms and in state-provided vocational schools. Transitions from the VET-system to the labour market are comparatively smooth in Germany, since apprentices and trainees are equipped with occupation-specific skills, granting employers longer screening periods (for a detailed discussion of the advantages of the 'dual system' see Dustmann/Schoenberg (2008)). Around one quarter of the respective age-groups attend such firm- or school-based vocational trainings, rendering tertiary academic graduation less frequent than in other countries (Statistisches Bundesamt 2009, p. 19).

The thus-defined immigrant employment sample is more strongly stratified by gender (male dominated) than is the full sample. Moreover, average tenure and language skills are lower in the immigrant samples. But beyond that, there are no strong differences in the mean characteristics of the different samples.

The descriptive statistics show that, due to the population considered in this survey and the inevitable sample restrictions, differences in observed characteristics between those with foreign degrees and the full sample are large for some decisive variables (e.g. education). Meanwhile, the distributions of other variables are similar between groups. Moreover, the sample size for those with (all their) foreign qualifications attained abroad is comparatively small. The sample size is further reduced if important variables enter a multivariate model simultaneously (n = 15,082). To nevertheless allow for a more thorough analysis of the (causal) effect of immigrant status on mismatching and the underlying mechanisms, we follow a propensity-score based reweighting approach, as presented in Nicols 2007, 2008. The basic concept is to first fit a logistic selection model of the "treatment" (in our case, immigrant status by definition 2[14]) to observable characteristics. The resulting propensity scores (multiplied by the sampling weight) are used to generate a weight variable that can be applied in the models of interests. By this approach, the observables of the control group (in our case the non-immigrants) are rendered comparable to the treatment group.[15] The estimate of the treatment variable in the weighted regression models, then, can be interpreted as a partial and causal effect (the relevant system of equations can be found in Nicols 2007).

As our treatment group, we use those individuals who achieved all their vocational degrees in a foreign country. Our selection model regresses this treatment group on gender, age group, highest vocational education attained[16], virtual years of education, experience, tenure, average weekly working hours, German language job skill requirements, occupational field[17] and five groups of employment status (blue collar worker, white collar worker, public servant, self-employed/free-lance worker/independent contractor, helping family members).

We present multivariate models for over-education and over-skilling, but not for under-qualification. This restriction is reasonable in light of the paper's focus on "brain waste or brain drain", and the fact that over-qualification is of much higher empirical relevance than under-qualification. The weighted regression models of over-education and over-skilling are presented

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[13] For self-employed employees, this variable equals the number of years the employee has operated the firm.
[14] Later versions of the paper will present analyses for definition 1 and 3 as well.
[15] Whether an adjustment between groups works well should be further tested in later versions of this paper, with sensitivity analyses that restrict the analyses to specific cases within narrowly defined "areas of common support".
[16] Balancing the groups by educational attainment does not affect the structural conditions of the sample in a way such that the effect of immigrant status on over-education and over-skilling is changed. Re-weighted regression models of over-education and over-skilling, with weights generated by a selection model without education (levels and years), generates substantially the same results as those presented in Table 4 below. Tables can be requested from the authors.
[17] Occupational fields are groups of occupations, defined by common most important job tasks being performed in the occupations (cf. Tiemann et al. 2008).

for the core employment population (25- to 64-year-olds) with full information on all variables used in the models, and are developed in three steps. The baseline model includes standard socio-demographic variables (gender, age group: 25–34, 35–44, 45–54, 55–64), as well as human capital variables (highest vocational degree, virtual years of education, experience, tenure) and controls (occupational field and employment status). To assess the validity of human capital and search theory, a second set of models additionaly includes the following (usually unobserved) skill measures: German language skills, state of health, and skill utilisation (the latter only in over-education models). Finally, in a third set of variables that might be associated with labour market rigidities also enter the models.[18] Whether there is a waste of talents among immigrants should then appear in significant and substantially large effects of immigrant status on over-education and over-skilling.

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[18] As it comes out, both variables are not significantly correlated with the outcome variables and do not affect the estimates of the other variables. We therefore do not present the results of the third specification.

4 Incidence of mismatching among immigrants

Table 2 shows the distribution of educational and skill mismatching in the full sample in comparison to the immigrant samples. First of all, results indicate that mismatching rates in Germany are comparatively low, in particular, when compared to the Anglo-Saxon countries (cf. McGuinness 2006; Groot/Maassen van den Brink 2000). Second, results for the full sample are consistent with the findings for earlier cross-sections of our survey (Rohrbach-Schmidt/ Tiemann 2011, 2014). We see that, at 84.0 percent, matching in terms of skills is more frequent than matching in terms of education, at 71.0 percent. For both measures, there are larger shares of workers with education or skills above, rather than below, the required level. Pearson's chi-squared test indicates that the mismatching measures are significantly related. However, with a Cramér's V value of .11, the relationship between the variables is rather minimal. This parallels to findings of Dutch and UK data (Green/McIntosh 2007). This also holds true for the three immigrant samples (Cramér's V def. 1 = .12, def. 2 = .10, def. 3 = .11).

As expected from the limited transferability of educational credentials, immigrants in fact have clearly higher percentages of over-education than non-immigrant workers. In all three immigrant samples, the share is more than ten percentage points above the share in the full sample. For individuals for whom German is not a first language and who hold at least one foreign educational degree (def. 3), the percentage of over-qualified workers is even more than 16 percentage points above the full sample. Contrastingly, figures for under-education (which are underrepresented) differ less between the full and immigrant samples.

Table 2

Educational and skills mismatch among immigrants

	Full sample	Immigrant sample def. 1	Immigrant sample def. 2	Immigrant sample def. 3
	Educational mismatch			
Under-educated	5.9	4.4	4.7	3.5
Match	71.0	60.4	57.9	56.7
Over-educated	**23.1**	**35.3**	**37.4**	**39.8**
Total	100.0	100.0	100.0	100.0
	Skills mismatch			
Under-skilled	3.8	8.1	8.4	10.4
Match	84.0	78.4	77.0	75.6
Over-skilled	**12.2**	**13.6**	**14.6**	**15.1**
Total	100.0	100.0	100.0	100.0

Note: [1] differences due to missing values. Immigrant sample definition 1 equals one if the respondent has achieved (one of) his or her vocational degree in a foreign country; definition 2 indicates whether the respondent has achieved all of his or her vocational degrees in a foreign country; definition 3 equals one if the respondent has achieved (one of) his or her vocational degree abroad and if his or her first language is not German.

Source: BIBB/BAuA Employment Survey 2012, weighted values, own calculations. Sample excludes workers without any vocational degree.

The results in the lower panel of Table 2 suggest that immigrant skills are not wasted to the same extent as are their human capital in the form of credentials: only 15 % or less of immigrant workers feel over-skilled which is barely higher than in the full sample. Contrary, the share of workers feeling under-skilled is about twice as high among immigrants than among workers in the full sample. Thus, it would appear that a lack of skills is more frequent within the immigrant samples than in the sample as a whole.

Previous studies, such as GREEN/McINTOSH (2007), have shown that individuals can be mismatched in terms of their education, even though their skills or abilities are in fact appropriate for the jobs that they do. Also, there are workers who are perfectly matched in regard to educational requirements, who nevertheless feel under- or over-challenged by their jobs' skill requirements. Following their approach, we decompose both measures (cf. Table 3, next page). Our findings are consistent with those for the UK: in the German labour market, to a sizable extent, the different types of (mis)matching are independent of one another. 'Real' mismatch—i. e. an over-qualification or under-qualification in both educational and skills-based terms—is extremely rare in the full sample (5.0 percent and 0.3 percent, respectively). A larger share of workers is inappropriately employed (only) in terms of their formal education (17.3 percent and 5.2 percent). Skill mismatch without educational mismatch occurs less frequently (6.7 percent and 2.7 percent).

The picture is somewhat, but not entirely, differerent for the immigrant samples. First, real under-qualification is a negligible phenomenon for immigrants as well. Second, only comparatively low shares of all mismatched workers are over-qualified in terms of both education and skills. The figures are, nevertheless, slightly above those for the full sample, and are highest for non-native speakers who graduated from foreign educational institutions (def. 3). Among this group, 8.0 percent of workers are not only over-educated, but also simultaneously under-utilise their skills. Compared to the full sample, too, over-education for immigrants is of much more relative importance than over-skilling; more than one fourth of immigrants are over-educated (but not over-skilled); in this immigrant population, we observe an under-utilisation of skills (without being over-educated) a bit more often.

Table 3

Decomposed mismatching among Immigrants

	Full sample	Immigrant sample def. 1	Immigrant sample def. 2	Immigrant sample def.3
Under–educated but not under–skilled	5.2	3.2	3.5	3.1
Under–skilled but not under–educated	2.7	4.2	4.4	5.9
Under–educated & under–skilled	0.3	0.3	0.3	0.0
Match	61.6	50.2	46.4	44.1
Over–educated but not over–skilled	17.3	24.6	26.7	27.0
Over–skilled but not over–educated	6.7	6.0	7.1	6.7
Over–educated & over–skilled	5.0	6.9	6.8	8.0
Other (over–educated & under–skilled; under–educated & over–skilled)	1.3	4.6	4.9	5.2
Total	100.0	100.0	100.0	100.0

Note: [1] differences due to missing values. Immigrant sample definition 1 equals one if the respondent has achieved (one of) his or her vocational degree in a foreign country; definition 2 indicates whether the respondent has achieved all of his or her vocational degrees in a foreign country; definition 3 equals one if the respondent has achieved (one of) his or her vocational degree(s) abroad and if his or her first language is not German.

Source: BIBB/BAuA Employment Survey 2012, weighted values, own calculations. Sample excludes workers without any vocational degree.

The decomposed results mirror the separate findings discussed before: immigrants show a higher percentage of over-education and under-skilling, respectively. Altogether, the results seem to support the view that immigrants have difficulty transferring their schooling and vocational educational capital to Germany. Consistent with search and match theory as well as human capital theory, as to which over-education might be temporary over the initial years in Germany, a relevant share of immigrant workers seem to take up jobs for which they are formally over-qualified (24.6 to 27.0 percent). In this group, workers cannot find jobs that match their qualifications. From signalling and institutional approaches, over-qualification might mostly be a result of the risk-averse behaviour of employers, who might be unclear on the true skill level signalled by the immigrants' qualifications. It thus follows that migrants would show higher percentages of over-education and over-skilling. In fact, up to 8.0 percent of the immigrant population seem to be over-educated and cannot utilise all their skills and abilities, and hence seem to waste their talents.

5 Models of over-education and over-skilling

Table 4 presents the results of two re-weighted logistic regression models of each—over-education and over-skilling, respectively. We thereby rely on definition 2 of immigrant status, i.e. immigrants who attained (all) their education outside Germany.[19] All specifications include measures of age group, occupation and employment status.

A central finding from these analyses is that the immigrant status has statistically significant effects on both over-education and over-skilling in all[20] specifications. This result should be particularily recognised, as the sample of immigrants defined here is a rather positively selected group of all migrants in Germany, and the separation of workers into the groups of immigrants and natives is controlled for in our approach through observable characteristics. This finding suggests that, to some extent, a waste of immigrants' talents is present in the German labour market.

First, the substantially higher probability of over-education among immigrants is consistent with human capital and search theory, as well as with institutional approaches and signalling (H1a). Contrary to this, the incidence of over-skilling seems to be significantly higher[21] among immigrants than among natives, even if usually unobserved skill differences between individuals are controlled for.[22] This suggests that, to some extent, and possibly because of institutional barriers, immigrants are not only less likely to use their formal qualifications, but are also less likely to (fully) utilise their skills. This result supports H2b, instead of H2a.

Comparing the base model with the skill heterogeneity specification reveals that, consistent with HCT and search theory, once skill utilisation is considered, the impact of immigrant status on over-education declines (H1b). In particular, and in accordance to the findings presented in Chiswick and Miller (2009) over-education declines with rising levels of language skills. However, on average, the impact decreases by only 0.4 percentage points. Moreover, with an average marginal effect of 7.7 percent, immigrant status substantially increases the probability of over-education, even if skill utilisation is controlled for. Fit-Statistics of both over-education models reveal that the skill heterogeneity model fits the data better than the base model.

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[19] As already stated, later versions of the paper should include the same analyses based on the other two definitions as well. However, inasmuch we focus on the limited transferability of human capital here, definition 2 is the one that is of most interest here.

[20] The third specification that additionally includes marital status and an indicator for children living in the workers' household is not presented. Both variables are not significantly correlated with the outcome variables and do not alter the estimates of the other variables.

[21] At around 2%, the average discrete change (DC) in the probability of over-skilling related to being or not being an immigrant, the average difference is not particularly large. However, with around 12% of individuals in the total sample being over-skilled (cp. Table 2), this increase at least corresponds to an increase of 17%. For over-education (23% in the total sample), the average DC of around 8% corresponds to a 35% increase.

[22] Even though a LR-test comparing both models shows no significant difference in -2LL and AIC does not improve, a small increase in Pseudo R2 provides some evidence for preferring the skill heterogeneity model of over-skilling. As compared to over-education, the association between over-skilling and standard human capital measures as well as language skills is, however, much lower. Whether skill differences are in fact less important for over-skilling or whether differences in skills are not well captured with these variables cannot be profoundly revealed.

Table 4

Re-weighted regression models of over-education and over-skilling

	Base model (M1)				Skill heterogeneity model (M2)			
	Over-education		Over-skilling		Over-education		Over-skilling	
	O.R.	AME	O.R.	AME	O.R.	AME	O.R.	AME
Immigrant	2.854**	.081	2.257*	.020	2.574**	.077	2.221*	.019
	(3.16)		(2.09)		(2.79)		(2.08)	
Experience	1.008	-.000	0.994	-.002	1.008	-.000	0.992	-.002
	(0.84)		(-0.56)		(0.88)		(-0.71)	
Exp.*Immigrant	0.975*		0.971+		0.979		0.971+	
	(-1.99)		(-1.90)		(-1.62)		(-1.89)	
Tenure	0.965***	-.006	0.963***	-.004	0.967***	-.005	0.964***	-.004
	(-6.21)		(-4.27)		(-5.71)		(-4.19)	
Female	2.328***	.149	1.081	.009	2.163***	.129	1.007	.001
	(7.12)		(0.51)		(6.15)		(0.05)	
Highest vocational education (Ref.: ISCED 5A)								
ISCED 3B	0.100***	-.355	0.904	-.012	0.081***	-.364	0.891	-.013
	(-9.85)		(-0.36)		(-10.41)		(-0.41)	
ISCED 5B	0.772	-.042	0.774	-.027	0.734	-.047	0.781	-.027
	(-0.72)		(-0.74)		(-0.84)		(-0.73)	
Virtual years of education	0.877**	-.022	1.091+	.010	0.884**	-.020	1.111*	.012
	(-3.18)		(1.90)		(-2.92)		(2.30)	
German language skills required (Ref.: no)								
Basis requir.					0.486***	-.122	0.904	-.012
					(-5.15)		(-0.62)	
Expert requir.					0.269***	-.224	0.654*	-.048
					(-7.96)		(-2.08)	
Over-skilling					2.037***	.123		
					(5.32)			
Age (4 groups) Occupation (12) Employment status	included included included		included included included		included included included		included included included	
McFadden's Pseudo-R²	.205		.094		.236		.103	
Nagelkerke Pseudo-R²	.212		.097		.243		.105	
-2LL	-518.718		-381.396		-498.476		-377.711	
AIC	.072		.054		.071		.054	
N	15,082		15,082		15,082		15,082	

Notes: Immigrant definition 2 (the respondent has achieved all his or her vocational degrees in a foreign country). Sample excludes workers without any vocational degree and those of ages below 25 and above 64. All models include age group (with 25–34 as referent), occupational field (12 groups with sales/trade occupations as referent) and employment status (five groups with blue-collar workers as referent). Skill heterogeneity models additionally control for state of health (not statistically significant). z statistics in parentheses (robust standard errors). + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: BIBB/BAuA Employment Survey 2012, weighted values, own calculations.

As already discussed, we cannot differentiate between labour market experiences gained in the home country or in Germany in our data. Because of this restriction, the following results on experience must be interpreted with caution: the base models give positive support for the idea that the incidence of over-education and over-skilling declines with immigrants' (total) labour market experience gained in Germany and possibly abroad. Conditional effects plots (on request) reveal that the difference in the predicted probability of over-skilling between immigrants and natives would diminish after 25 years of labour market experiences, whereas this would need around 40 years of experience for over-education. With an average of 22.8 years of labour market experience in our immigrant sample (see Table 1) and a maximum of 48 years, most immigrants would not experience such compensation in their risk of over-education over the course of their career cycles (H3b).

In addition to models presented in Table 4 (M1, M2), we estimated a base model and a skill heterogeneity model for over-education using information on the region[23] where the foreign vocational degree was attained. These models suggest that immigrants from different geographical regions have different risks of over-education. Whereas immigrants with degrees attained in EU-countries and Switzerland, EU-Candidate countries and America do not differ from those with German degrees, immigrants who attained their vocational education in other European countries (Russia and other) or Asia face above-average risks of over-education.

Lehmer/Ludsteck[24] (2011) suggest there are substantial wage-penalties resulting from over-qualification among immigrants. Regressing log hourly wages on over-education and a number of controls (see Table II in the appendix), we find that overeducated immigrants earn around 17% less than their non-overeducated immigrant co-workers. Over-education and over-skilling (while only statistically significant in the total sample) are robust predictors of wages, which further supports the view that immigrant over-qualification is an important issue to study.

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[23] Because of the sample size restrictions, we do not use available information on the country, but summarise countries into the following groups: EU-countries and Switzerland, EU-Candidate countries, other European countries (Russia, Ukraine, Bosnia-Herzegovina, Moldova, Kosovo), North America, Central/South America, Asia.

[24] Lehmer/Ludsteck (2011) analyse German Employment Register Data in trying to answer the question of the native-foreigner wage gap in Germany. Due to the possibilities their sample allows, they compare different immigrant groups (by nationality) to Germans and also decompose the wage-gap into an unexplained wage-gap (aka discrimination) and a worker-heterogeneity (i.e. characteristics) part. They do not, however, have an indicator for over-education or even overskilling, as they can only control for the qualification levels of employees, which is reported by employers and might therefore be biased and mask over-education (cf. p. 879). They find considerable shares of the wage-gaps for some nationalities being explained by discrimination (unexplained wage gap), which "decreases for most countries by about 20–30 percent after controlling for occupational segregation" (888), when they still find an unexplained wage gap between 4 and 17 percent (cf. 889). Their results suggest "that immigrants are generally affected by 'pure' wage "discrimination". Contrasting the effects for workers from Eastern European EU member countries with those for classical EU member states or Turkey, it emerges that coefficient effects tend to be somewhat higher for the former group. An equivalent indication for discrimination is found for immigrants from Eastern European non-EU member states. It should be noted, however, that we find considerable heterogeneity also within nationality groups, indicating that Eastern Europeans are not generally worse off" (p. 896).

6 Summary and Conclusion

So far, only limited evidence exists on skill utilisation among immigrants beyond over- or under-education. Our study tries to fill this gap by exploiting recent data of the BIBB/BAuA Employment Survey 2012, which allow for observing both educational and skill mismatch among workers with (all their) formal qualifications attained outside Germany. We thereby focus on a sample of immigrant workers which is comparatively highly qualified, and which thus respresents a selective sample of the much larger group of migrants in Germany.

The results suggest that, to some extent, a waste of immigrants' talents takes place in the German labour market. An immigrant status has statistically significant effects on both over-education and over-skilling, over and above the effects of human capital, socio-demographic variables and (in most studies not observed) skill measures. Our results suggest that immigrants' over-qualification is more a problem of over-education and less of over-skilling. Caution, however, is advised with interpreting this finding as an indication of no substantial waste of immigrants' talents in the German labour market. First, the measure of self-reported skill mismatching used here might not only capture the degree to which individuals' skills match the skills required at their workplace (even though this is explicitly stated in the question), but might also caputre other dimensions of mismatches that give rise to the feeling of being under-/overstrained (e. g. time pressure, working time etc.). Second, there seem to be considerable wage-penalties from over-education among immigrants in our sample. This might likely cause deficits in motivation and productivity.

Important sensitivity analyses and robustness checks include alternating: i) the sample definition in the regression models, ii) the selection model, and iii) the model specifications. With regard to the latter, a closer analysis of the country of educational origin, the degree of occupational closure, job task content and the inclusion of a broader set of job competencies might be valuable to consider.

If the above findings are validated, this might give reason for further research that focuses on firms' recruiting and promoting processes. Equally, studies that take into account the barriers to attaining further qualifications in Germany would be valuable complements to the findings presented here. From a policy perspective, policies like the Federal Recognition Act seem to hint in the right direction. Since this law has only been in use since 2012, it is not yet possible to say much about its effectiveness, especially regarding the prevention of possible mismatching. There is a yearly report on the monitoring of the execution of the Recognition Act, and it remains to be seen how well it is working.

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Appendix

Table I
Educational categories

Respondent's highest vocational education and training qualification/ qualificational requirements of respondent's job	Abbreviation used throughout the text
No vocational education and training qualification	No qualification
Completed vocational education and training qualification, including school-based vocational training	Dual/school-based training (ISCED 3B)
Master craftsman or technician qualification, trade and technical school qualification	Advanced training (ISCED 5B)
University of Applied Sciences or university qualification	Academic education qualification (ISCED 5A)

Table II
OLS-model of log hourly wages

	Immigrant sample	Sample without immigrants
Over-educated	-0.174*	-0.142***
	(-2.24)	(-10.98)
Over-skilled	-0.055	-0.056***
	(-0.93)	(-3.66)
Germ. lang. skills required (Ref.: no)		
Basic requirements	-0.027	0.054**
	(-0.35)	(2.69)
Expert requirements	-0.066	0.122***
	(-0.79)	(5.75)
Experience	0.012*	0.000
	(2.31)	(0.22)
Tenure	0.016***	0.013***
	(5.11)	(26.46)
Female	-0.254***	-0.168***
	(-3.92)	(-14.56)
Highest voc. Educ. (Ref. ISCED 5A)		
ISCED 3B	-0.172*	-0.252***
	(-2.00)	(-13.77)
ISCED 5B	-0.195	-0.140***
	(-1.21)	(-7.33)

(Continuing Table II)

	Immigrant sample	Sample without immigrants
Virtual years of education	0.021	0.024***
	(1.52)	(6.78)
Constant	2.249***	2.363***
	(7.21)	(34.18)
R^2	0.492	0.342
N	341	14,740

Notes: Immigrant definition 2 (the respondent has achieved all his or her vocational degrees in a foreign country). Sample excludes workers without any vocational degree and those of age below 25 and age above 64. Both models include age group (with 25–34 as referent), occupational field (12 groups with sales/trade occupations as referent). Robust t statistics in parentheses: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: BIBB/BAuA Employment Survey 2012, weighted values, own calculations.

Abstract

So far, only limited evidence exists on skill utilisation beyond over- or under-education among immigrants. Our study tries to fill this gap by exploiting recent data of the BIBB/BAuA Employment Survey 2012, which allow for observing levels of both educational and skill mismatch among workers with foreign qualifications. For this, we focus on a sample of immigrant workers that is comparatively highly qualified, and thus respresents a selective sample of the much larger group of all migrants in Germany. The results of a propensity-score based reweighting approach suggest that, even in this selective group, being an immigrant significantly increases the probability of being over-educated, but that some part of the educational mismatch can be attributed to skills heterogeneity.

Bisher liegen keine Arbeiten zur Ausnützung von fachlichen Kenntnissen und Fähigkeiten im Zusammenhang mit formaler Fehlqualifizierung bei erwerbstätigen Immigranten in Deutschland vor. Die Studie schließt diese Forschungslücke mit Daten der BIBB/BAuA Erwerbstätigenbefragung 2012, welche Angaben zur Passung der Qualifikationen als auch der fachlichen Kenntnisse und Fähigkeiten enthält. Hiermit wird auf eine Stichprobe von Immigranten fokussiert, die vergleichsweise hochqualifiziert und als Kernerwerbstätige bereits in den Arbeitsmarkt integriert ist. Die Ergebnisse eines re-weighting regression Ansatzes zeigen, dass für diese selektive Gruppe von Immigranten eine signifikant höhere Wahrscheinlichkeit besteht, formal überqualifiziert zu sein und keine Erwerbstätigkeit gemäß der fachlichen Kenntnisse auszuüben.

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