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Wage Effects of Educational Mismatch According to Workers' Origin: The Role of Demographics and Firm Characteristics

Valentine Jacobs, François Rycx, and Mélanie Volral

This paper examines the influence of educational mismatch on wages according to workers' region of birth, taking advantage of our access to rich matched employer-employee data for the Belgian private sector for the period 1999-2010. Using a fine-grained approach to measuring educational mismatch and controlling for a large set of covariates, we first find that workers born in developed countries benefit from positive wage returns to their years of attained-, required and over-education, and that these returns are significantly higher for them than for their peers born in developing countries. Second, our results show that the wage return to a year of over-education is positive but lower than that to a year of required education. This suggests that over-educated workers suffer a wage penalty compared to their well-matched former classmates (i.e. workers with the same level of education in jobs that match their education). However, the magnitude of this wage penalty is found to vary considerably depending on the origin of the workers. Indeed, all else being equal, our estimates show that it is much greater for workers from developing countries – especially for those born in Africa and the Middle and Near East – than for those from developed countries. Regardless of workers' origin, our estimates further indicate that the wage penalty associated with over-education is higher for workers who: i) have attained tertiary education, ii) are male, iii) have more seniority in employment, iv) are employed in smaller firms, and v) are covered by a collective agreement at the firm level. Yet, whatever the moderating variable under consideration, the estimates also show that the wage penalty associated with over-education remains higher for workers born in developing countries.

Keywords Immigrants, educational mismatch, wage gap, linked employer-employee data.

JEL Classifications I24; I26; J15; J24; J31.

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Abstract

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1. Introduction

Educational mismatch has become a major challenge for societies over time. Over the past years, our advanced economies have been facing a constant increase in the workers' level of education. For instance, the tertiary attainment level in the EU27 countries for workers aged 30-34 increased from 22.4% in 2000 to 40.3% in 2019 (European Commission, 2012, 2020). Educational mismatch (Freeman, 1976) occurs when this increasing level of education is not matched by jobs requiring increasing skills. Workers are then considered as either over-educated when their level of attained education is higher than the level of education required for their jobs, or under-educated in the opposite case. The latest data from Eurostat show that over-education is an important phenomenon that concerned 21.5% of workers in the EU27 countries in 2020 (Eurostat, 2021). At the same time, a large body of the literature emphasizes that immigrants are much more likely to be over-educated than their native counterparts (e.g. Wald and Fang, 2008; Nielsen, 2011; Joonas *et al.*, 2014; Jacobs *et al.*, 2021), which is generally explained by imperfect transferability of human capital and discrimination (e.g. Chiswick and Miller, 2009a; Aleksynska and Tritah, 2013; Matano *et al.*, 2015).

The influence of workers' over-education on wages has been intensively studied. On the one hand, studies find that over-educated workers earn, *ceteris paribus*, higher wages than their adequately educated colleagues in similar jobs, a result that can be interpreted in the light of human capital or assignment theories (e.g. Duncan and Hoffman, 1981; Rumberger, 1987; Chiswick and Miller, 2008; McGuinness and Sloane, 2011; Joonas *et al.*, 2014). In the literature, this wage premium is generally referred to as the 'return' to over-education. On the other hand, estimates indicate that over-educated workers earn, *ceteris paribus*, a smaller wage than their former classmates employed in jobs that match their level of education. The under-utilisation of the skills of over-educated workers thus appears to generate a wage penalty. In other words, results suggest that over-educated workers would earn a higher wage if they could access a job that matches their educational level (e.g. Verdugo and Verdugo, 1989; Lindley, 2009; Kalfa and Piracha, 2017).

From a theoretical point of view, factors such as the imperfect transferability of human capital and discrimination, which have been identified as causing a higher incidence of over-education among immigrants, are also likely to cause a lower return (or a larger wage penalty¹) to over-education for immigrants than for natives (e.g. Chiswick and Miller, 2009a). Empirical

¹ If the comparison group consists of well-matched former classmates rather than well-matched colleagues.

studies analysing the wage effects of educational mismatch for natives and immigrants tend to support this prediction. Whereas some papers show that the wage returns to required and over-education are both significantly lower among immigrants (e.g. Battu and Sloane, 2004; Wald and Fang, 2008), other studies find that immigrants only suffer from a lower return to over-education (e.g. Chiswick and Miller, 2008, 2010; Nielsen, 2011; Joonas *et al.*, 2014; Schwientek, 2016).

Despite the growing number of studies comparing the wage premia (or penalties) associated with over-education for natives and immigrants, very little is known on whether and how moderating factors might influence these earnings' differentials. Accordingly, our paper aims to fill this gap by investigating the role of a large range of key worker and firm characteristics. More precisely, our study is one of the first to take explicit account of the heterogeneity of immigrants in terms of regions of birth (e.g. Green *et al.*, 2007; Kler, 2007; Chiswick and Miller, 2008; Joonas *et al.*, 2014). Considering immigrants (i.e. foreign-born people) as a homogeneous group indeed hides significant disparities in labour market performance. Across Europe, we can distinguish two groups of immigrants: on the one hand, people born in developed countries, whose employment rate and earnings are very close to those of natives in all countries, and on the other hand, immigrants born in developing or transition economies, whose access to employment is much more problematic and whose earnings are significantly lower on average. Belgium is no exception in this respect. We therefore decided to go beyond the traditional 'native vs. immigrant' approach and to estimate the wage penalty associated with over-education for workers born in developed and in developing countries, respectively.² However, given the diversity among immigrants from developing countries, which has been shown to influence the transferability of human capital (Ramos *et al.*, 2015), the probability of being over-educated (Jacobs *et al.*, 2021), and the extent of wage discrimination (Grinza *et al.*, 2020; Fays *et al.*, 2021), we further distinguish immigrants from developing countries according to whether they were born in: i) Africa, ii) the Middle and Near East, iii) Asia, iv) Eastern Europe (non-EU), and v) Latin and Central America.³

Our paper also contributes to the existing literature by investigating the role played by gender and education, two moderating variables that have so far received little attention. Some evidence suggests that the wage penalty associated with over-education is more pronounced among high-educated workers, and especially among high-educated immigrants (Kler, 2007;

² By developing countries, we refer to both transition and developing countries, as listed in the UNCTAD (2020) classification.

³ A detailed description of these country categories is provided in Appendix 1.

Chiswick and Miller, 2009b). However, more research is needed in this area to draw more comprehensive conclusions. With regard to gender, the results are few and somewhat mixed. In particular, it is still unsettled whether over-educated female immigrants suffer a double wage penalty, i.e. a wage penalty that corresponds to the sum of the over-education penalty faced by women and that faced by immigrants (Lindley, 2009; Joon *et al.*, 2014).

Finally, we investigate whether tenure (i.e. the number of years an employee has worked for her/his current employer), firm size and firm-level collective agreements affect the over-education wage penalty for workers originating from different regions in the same way. To the best of our knowledge, the role of these moderating variables has never been explored in this context before. All three variables are known to foster workers' wages (Lallemand *et al.*, 2007; Garnero *et al.*, 2020; Gagliardi *et al.*, 2021) and some studies suggest that they affect workers' likelihood of being over-educated (Jacobs *et al.*, 2021). However, they may also influence the wage penalty associated with over-education for workers from developed and developing countries. If the larger penalty faced by immigrants (and, in our setup, by workers born in developing countries) is driven by statistical discrimination, then we might expect differences in penalties according to workers' origin to decrease as years of tenure increase. However, if differences in penalties are due to other phenomena (such as taste-based discrimination or unobserved differences in actual skills), then the effect of tenure is more likely to be non-significant or at least quite limited. Firm size and collective agreements are also likely to play a significant role. From a theoretical perspective, some arguments suggest that differences in penalties according to workers' origin will be smaller: i) in bigger firms due to their more transparent and efficient human resource management practices, and ii) in the presence of firm-level collective agreements, as trade unions often present themselves as advocates of fair working conditions for vulnerable groups (e.g. Dell'Aringa and Lucifora, 1994; Lallemand and Rycx, 2006; Plasman *et al.*, 2007). However, there are also theoretical predictions pointing in the opposite direction. For instance, it could be argued that because bigger businesses have more detailed job nomenclatures, minority groups (i.e. over-educated workers from developing countries) are more likely to be clustered into discriminated categories in these businesses and, accordingly, to face a higher wage penalty. Moreover, unions could actually prioritize the exclusive interests of workers born in developed countries, in particular when the trade union density is smaller among those from developing countries (Kampelmann, 2011). The effect of unions, and more specifically of firm-level collective agreements, could thus also be detrimental to the wages of over-educated workers from developing countries.

To examine the influence of educational mismatch on wages according to workers' region of birth, and to assess the moderating role of a wide range of worker and firm characteristics, we rely on detailed matched employer-employee data for Belgium, covering the period 1999-2010. This dataset comes from the combination of i) the "Structure of Earnings Survey" (SES), which contains relevant information on the characteristics of firms (e.g. sector of activity, number of employees, level of collective agreement) and their workers (e.g. age, education, occupation, gender, tenure, working time), and ii) the Belgian Population Register, which provides relevant information on workers' origin (i.e. country of birth). This dataset, covering more than 1.2 million workers, allows us to categorize workers according to whether they were born in a developed or developing country, but also according to disaggregated geographical areas. Moreover, it enables us to measure over-education using the 'realized matched method' in a more detailed and hence more accurate manner than most previous studies. According to this method, a worker is considered as over-educated if her/his educational attainment is higher than the one required for her/his job. Traditionally, the required education for a job is estimated using the mode (Kiker *et al.*, 1997) or the mean (Verdugo and Verdugo, 1989) of the education levels by occupation. However, this approach does not account for cohort effects, i.e. the fact that levels of education have substantially increased over time and that the education credentials of older workers can therefore hardly be compared directly with those of their younger co-workers. Furthermore, the education requirements for a given occupation are likely to vary across sectors. For example, the requirements for a project manager position in the nuclear industry will likely be very different from those for a job in retailing. To account for both issues, we compute the education requirements for a job by taking the mode of the education levels by detailed occupation, workers' age, and sectoral category. The required education is thus estimated by measuring the mode of the education levels in more than 5,400 occupation/age/industry cells for each period.

Overall, our paper contributes to the existing literature in several ways. Besides being the first study to examine the wage penalty associated with over-education as a function of workers' origin in the Belgian context, we provide a methodological improvement by relying on a more precise approach to measuring educational requirements and mismatch. Moreover, by using a more refined definition of workers' origin, going beyond the usual dichotomy between natives and immigrants, we depart from most previous studies that (at least implicitly) assumed that immigrants are a homogeneous group regardless of their region of birth. Finally, we contribute to current knowledge by providing a better understanding of key moderating factors in the relationship between educational mismatch and the wages of workers of different origins. More precisely, our

study is the first to investigate the moderating role of tenure, firm size, and collective bargaining, and one of the few to examine interaction effects with demographics (education and gender).

The remainder of this paper is organised as follows. Section 2 reviews the literature regarding the influence of educational mismatch on wages according to workers' origin and the potential role played by various moderating factors in this relationship. We describe our methodology in Section 3 and present the data set in Section 4. Econometric results are presented in Section 5, and Section 6 finally concludes.

2. Literature Review

2.1. The effect of educational mismatch on wages

The literature on returns to education started with Mincer (1974), who argued that years of education are a key determinant of wages. Subsequently, Duncan and Hoffman (1981) introduced a distinction between the educational attainments of workers and the educational requirements of jobs, in order to analyse the wage effects of educational mismatch. Their main contribution has thus been to broaden the discussion on the importance of job characteristics in determining wages, thereby expanding the human capital framework (Sloane, 2003; Karakaya *et al.*, 2007). Indeed, both supply and demand sides of the labour market are then considered in the context of the assignment model (Sattinger, 1993), which successfully balances the human capital theory (Becker, 1964) and the job competition theory (Thurow, 1975). In other words, wages are assumed to depend on the productivity of the workers, which is constrained by both their human capital (i.e. workers' educational attainments) and the characteristics of their job (i.e. the educational requirements of the job).

In that context, the relationship between over-education and productivity is ambiguous (Kampelmann and Rycx, 2012; Mahy *et al.*, 2015; Kampelmann *et al.*, 2020). On the one hand, over-educated workers could be less productive than if they had been employed in a job matching their education level, as they probably under-use their skills in that situation (Nielsen, 2011). This could in turn make them less satisfied and/or more frustrated (Vroom, 1964). On the other hand, over-educated workers could be more productive than their adequately educated colleagues in similar jobs, since they have more human capital (Becker, 1964). Accordingly, over-educated workers should thus earn a higher wage than their adequately educated peers, but still a smaller wage than if they had occupied a position matching their education level (e.g. Duncan and Hoffman, 1981; Rumberger, 1987; Verdugo and Verdugo, 1989; Rubb, 2003). These theoretical predictions

are supported by numerous empirical studies (e.g. Battu *et al.*, 1999; Dolton and Vignoles, 2000). For instance, on the basis of the PIAAC data for Spain between 2011 and 2012, Nieto and Ramos (2017) find that the return to over-education is positive but lower than the return to required education (3% vs. 7.2%, respectively).

2.2. Educational mismatch and wages according to the workers' origin

The relationship between educational mismatch and wages may further vary depending on whether the worker is native or immigrant, for two main theoretical reasons. The first reason is the transferability of human capital, which depends notably on the closeness of the educational systems, the languages, the levels of economic development, and the industrial structures of the home and host countries. The more these countries differ, the greater the likelihood that immigrants will be over-educated (e.g. Friedberg, 2000; Chiswick and Miller, 2009a; Aleksynska and Tritah, 2013; Kalfa and Piracha, 2017) and the lower the returns to education for immigrants (Basilio *et al.*, 2017).

The second reason is wage discrimination, which occurs when an employer pays different wages to two equally productive workers as a result of different non-productive characteristics, such as origin or gender (Heckman, 1998). On the one hand, the statistical discrimination theory (Phelps, 1972; Arrow, 1973) postulates that employers have more information about the productivity of native applicants who have obtained previous educational and professional credentials in their countries, and this theory therefore refers to the negative stereotypes of employers when assessing the productivity of immigrant applicants. This leads to the conclusion that immigrants may be penalised for difficulties in reporting their real productivity.

On the other hand, the taste-based discrimination theory, developed by Becker (1957), assumes that some employers/customers/co-workers are prejudiced against a specific characteristic of workers, such as the region of birth. This prejudice translates into a disutility for the prejudiced individual when she/he is in contact with the type of worker she/he dislikes. Hence, immigrants will have greater difficulty in finding a job that matches their level of education and thus will be more likely to accept jobs for which they will be over-educated (Lindley, 2009). In addition, prejudiced employers will be willing to hire immigrants if and only if they can pay them less to compensate for the disutility suffered. Consequently, immigrants will be more likely to be over-educated and to suffer a wage penalty.

Finally, the monopsonistic discrimination theory (Hirsch and Jahn, 2015) suggests that immigrant applicants have less information about the labour market of their host country and are

therefore more likely to suffer from employers' monopsonistic behaviour and, consequently, to perceive lower wages than their native counterparts.

Empirical studies analysing the wage effects of educational mismatch for natives and immigrants tend to support these predictions. Some papers show that the wage returns to required and over-education are both significantly lower among immigrants (e.g. Battu and Sloane, 2004; Wald and Fang, 2008), and other studies find that immigrants only suffer a lower return to over-education (e.g. Chiswick and Miller, 2008, 2010; Nielsen, 2011; Joona *et al.*, 2014; Schwientek, 2016).

2.3. The role of demographics and firm characteristics

Some studies go a step further by considering the role of moderating factors in the relationship between educational mismatch and wages according to workers' origin. First, a few studies investigate the potential variations when considering the region of birth more precisely than the standard dichotomy between natives and immigrants. Immigrants born in different regions might indeed present quite different characteristics in terms of human capital, culture, and/or languages (Ramos *et al.*, 2015; FPS Employment and Unia, 2017). In addition, various studies highlight that the probability of being over-educated (e.g. Jacobs *et al.*, 2021) and the extent of wage discrimination (e.g. Fays *et al.*, 2021) depend on immigrants' region of birth. For instance, analysing the US labour market using data from the 2000 Census, Chiswick and Miller (2008) find that the returns to required education are highly heterogeneous, ranging from 9% (e.g. among immigrants from Eastern Europe, and Mexico) to 20% (e.g. among those from Australia, and New Zealand), and that the returns to over-education vary from 0% (e.g. among immigrants from Southern and Eastern Europe, Canada, Australia, and Japan) to 10% (e.g. among those from China). Using immigrant longitudinal data, Green *et al.* (2007) and Kler (2007) also put forward evidence of heterogeneous returns to education in Australia. More precisely, Green *et al.* (2007) find that the returns to required education fluctuate from 8% (i.e. among non-English-speaking background (NESB) immigrants) to 14% (i.e. among English-speaking background (ESB) immigrants) and that the returns to over-education vary from 3% (i.e. among Asian NESB immigrants) to 8% (i.e. among ESB immigrants). The results presented by Joona *et al.* (2014) are in the same line: on the basis of Swedish register data for the period 2001-2008, they indicate that the return to over-education is lower for non-Western immigrants, followed by Western immigrants and natives (1.7%, 4.7%, and 6.0%, respectively). As far as Belgium is concerned, immigrant workers from the Middle and Near East and from Africa are particularly often singled out as having the least enviable situation on the

labour market (e.g. FPS Employment and Unia, 2019; Piton and Rycx, 2021). We therefore expect the penalty associated with over-education to be especially high for these workers.

The imperfect transferability of human capital, and thereby the returns to education, may also vary according to workers' level of education. Indeed, the difficulty for immigrants to have their diplomas or certificates recognised in the host country not only varies according to the country where these education credentials were obtained, but also considerably depends on the level of education attained (Chiswick and Miller, 2008, 2009b). To the best of our knowledge, only two papers analyse the wage effects of over-education by focusing on a sample of higher-educated natives and immigrants (Kler, 2007; Chiswick and Miller, 2009b). Both find positive returns to over-education, but these returns are significantly lower than those to required education, especially for immigrants. This results in particularly high penalties associated with over-education for higher-educated immigrants.

Another moderating factor that has received little attention so far is gender. It has been widely shown that women in developed countries perceive lower wages, on average, than men, even when differences in productive characteristics are considered. This wage gap is largely explained by gender segregation by industry and/or occupation and by statistical and/or taste-based discrimination (e.g. Salinas-Jiménez *et al.*, 2013; Garnero *et al.*, 2014). Empirical evidence regarding the influence of educational mismatch on wages according to gender is not univocal. Some studies suggest that women suffer higher over-education penalties than men (e.g. Cohn and Ng, 2000 for Hong Kong; Dolton and Vignoles, 2000 for the UK; Rubb, 2003 for the US; Salinas-Jimenez *et al.*, 2013 for Spain), whereas others reach to the opposite conclusion (e.g. Daly *et al.*, 2000 for Germany; Ren and Miller, 2011 for China). Only a few studies have examined the potential interaction of this relationship with origin, and their results are also mixed. Analysing the Quarterly Labour Force Survey for the period 1993-2003 in the UK, Lindley (2009: 80) finds that the penalties related to over-education substantially vary across origin, minority ethnic groups, and gender. More precisely, she obtains significantly larger over-education penalties for South Asian immigrants and native men, as well as for white immigrant men, black women, and white UK born women. On the other hand, using Swedish register data for the period 2001-2008, Joona *et al.* (2014) find that all female workers suffer higher over-education penalties, and these penalties are particularly pronounced for women originating from non-Western countries, resulting in a double penalty for them.

Besides examining the role played by workers' region of birth, education level, and gender, we also aim to investigate the influence of tenure in the relationship between over-education and wages according to workers' origin. To our knowledge, this has never been investigated before.

The number of years an employee has been working for her/his current employer has a positive effect on wages (Allen and van der Velden, 2001; Tsai, 2010; Gagliardi *et al.*, 2021). This can be explained partly by the fact that asymmetrical information on workers' true productivity diminishes as years of tenure increase.⁴ If immigrant workers suffer from some statistical discrimination, tenure could thus attenuate the difference in the returns to education between native and immigrant workers. In contrast, if the difference in returns is due to other phenomena (such as taste-based discrimination or unobserved differences between natives and immigrants in terms of preferences and/or actual skills), then the effect of tenure is more likely to be non-significant or at least quite limited.

Finally, this paper is also the first to examine the role of firm size and the presence of firm-level collective bargaining as moderating factors. On the one hand, larger firms tend to have more transparent and efficient human resource management practices, particularly in terms of recruitment, pay scales, evaluation, and promotion, thus reducing the opportunities for wage discrimination (e.g. Lallemand and Rycx, 2006; Lallemand *et al.*, 2007; Cornelissen and Jirahn, 2012). On the other hand, trade unions often present themselves as advocates of fair working conditions for vulnerable groups (Dell'Aringa and Lucifora, 1994; Plasman *et al.*, 2007; OECD, 2018; Garnero *et al.*, 2020). Following these arguments, immigrant workers could therefore benefit more from their investment in education if they work in a large firm and/or in the presence of a firm-level collective agreement. However, theoretical predictions also point in the opposite direction. For instance, it could be argued that because smaller businesses have less detailed job nomenclatures, minority groups are less likely to be clustered into discriminated categories in these businesses, i.e. in occupations for which they are over-educated and under-paid (Kampelmann and Rycx, 2016). It is also asserted that unions could prioritize the exclusive interests of native workers, which could particularly be the case when foreigners are less often affiliated with trade union organizations (Kampelmann, 2011). Empirical studies indeed show that the question of whether unions are inclusive or exclusive towards workers with a migration background has not been settled yet. In the case of New Zealand, for instance, Harcourt *et al.* (2008) argue that trade unions, contrary to the rhetoric, are relatively unsuccessful in combating discrimination against foreigners and ethnic minorities. In contrast, the results for Belgium suggest that wage discrimination against immigrants is alleviated in the presence of stronger collective bargaining (Grinza *et al.*, 2020).

⁴ A further, non-negligible, explanation – besides human capital theory – is that collective labour agreements generally provide for normative pay scales in terms of wage levels and progression (e.g. promotion, seniority), especially for white-collar workers in the Belgian context (Garnero *et al.*, 2020).

Moreover, Jacobs *et al.* (2021) find that the likelihood of over-education among immigrants from developing countries is significantly lower in bigger firms and when working conditions are collectively renegotiated at the firm level. Our paper therefore aims to take these results a step further by investigating whether the difference in over-education wage penalties faced by workers born in developed and developing countries is smaller in larger firms and in the presence of firm-level collective agreements.

3. Methodology

3.1. Measuring educational mismatch

In the literature, there are three main approaches used to measure educational mismatch: the job analysis (JA), realized matches (RM), and worker self-assessment (WA) methods. The JA approach provides an objective measurement based on analysts' criteria to determine the education requirement for a job to be compared with workers' educational attainments; the RM is a statistical approach that compares workers' educational attainments with those of workers in the same occupation using the mean (Verdugo and Verdugo, 1989) or modal value (Kiker *et al.*, 1997) as reference; and the WA offers a subjective measurement based on surveys in which workers are asked to evaluate the level of education required to do their jobs.

These measurements all have advantages and shortcomings (see e.g. Hartog, 2000 for a discussion), so that the approach chosen in practice is often driven by data availability. In this paper, we rely on the RM approach. Traditionally, this approach boils down to defining the level of education required for a job by computing the mode of the education levels for this occupation, and then classifying a worker as over-educated if her/his level of education exceeds that required for her/his job. We refine this approach by considering not only the worker's occupation, but also her/his age and the sector in which she/he is employed. More precisely, we define the required level of education by taking the mode of the education levels (ISCED: 7 categories)⁵ by occupation (ISCO 3-digit: 150 categories), age group (6 categories)⁶, and sector (NACE Rev. 2 at the 1-digit

⁵ Information on workers' educational attainments, available in 7 categories in our dataset, has been reported by firms' HR departments (based on their registers). We converted that information into years of education, applying the following rule: (i) primary education: 6 years of education; (ii) lower secondary education: 9 years; (iii-iv) general, technical, and artistic upper secondary education: 12 years; (v) higher university and non-university education, short type: 15 years; (vi) university and non-university education, long type: 17 years; and (vii) postgraduate education: 18 years. Given that information on workers' levels of education was provided by firms' HR departments, these levels might be somewhat under-estimated for immigrants. The findings reported in this paper should therefore be considered as a lower bound.

⁶ We classified the age groups as follows: 15-29; 30-34; 35-39; 40-44; 45-49; and 50+.

level: 13 categories)⁷. This results in 5,407 groups instead of around 150 if the analysis had been based solely on ISCO 3-digit occupations. This fine-grained approach enables us to control for cohort effects, the increasing supply of education credentials, and education requirements that are very likely to vary across sectors in given occupations.

3.2. Returns to attained-, required and over-education

As a benchmark, we first estimate the following standard Mincer specification (1974) on two subsamples consisting of workers coming from developed and developing countries, respectively:

$$\ln W_i = \beta_0 + \beta_1 S_i^a + \beta_2 X_i + u_i \quad (1)$$

where the dependent variable $\ln W_i$ denotes the logarithm of the gross hourly wage of worker i , including premia for overtime, weekend and/or night work, bonuses and other premia; S_i^a is the worker's number of years of education (i.e. the attained education level), β_1 therefore measuring the return to an additional year of education; and X_i is a vector containing a set of detailed worker, job, and firm characteristics. Regarding workers characteristics, this vector includes a dummy for gender (set equal to 1 if the worker is a woman, and 0 otherwise), a dummy for tenure (set equal to 1 if a worker has been working for at least 10 years with her/his current employer, and 0 otherwise), three dummies for the type of employment contract (i.e. fixed-term, apprenticeship, and temporary agency contracts, respectively; open-ended contracts being the reference category), a dummy for part-time work, and three or four dummies to control for the worker's region of origin, depending on the subsample being analysed (more precisely, three dummies are included for the subsample of workers born in developed countries (i.e. Eastern Europe (EU), North America and South Pacific, and Japan; Western Europe being the reference category) and four dummies are included in the regression on workers born in developing countries (i.e. Eastern Europe (non-EU), Asia, Latin and Central America, Middle and Near East; Africa being the reference category)). X_i further contains two dummies for the region where the firm is located (i.e. Brussels and Wallonia, respectively;

⁷ It covers the following sectors: (i) mining and quarrying (B); (ii) manufacturing (C); (iii) electricity, gas, steam and air conditioning supply (D); (iv) water supply, sewerage, waste management and remediation activities (E); (v) construction (F); (vi) wholesale and retail trade, repair of motor vehicles and motorcycles (G); (vii) transportation and storage (H); (viii) accommodation and food service activities (I); (ix) information and communication (J); (x) financial and insurance activities (K); (xi) real estate activities (L); (xii) professional, scientific and technical activities (M); and (xiii) administrative and support service activities (N).

Flanders being the reference category), two dummies for the size of the firm (i.e. 50-249 and more than 250 full-time equivalent (FTE) employees, respectively; 10-49 FTE employees being the reference category), a dummy for the firm's economic and financial control (set equal to 1 if public ownership exceeds 50%, and 0 otherwise), a dummy taking the value 1 if the firm is covered by a firm-level collective agreement and 0 otherwise (i.e. if it is covered solely by a national and sectoral collective agreement),⁸ and 11 year dummies.

Next, two specifications further improve the traditional Mincer wage equation by making a distinction between the workers' educational attainments and the educational requirements of the job, in order to analyse the wage effects of educational mismatch. The first is the dummies specification (or VV specification) developed by Verdugo and Verdugo (1989), which includes, in addition to the number of years of attained education (S_i^a), two dummy variables for over-education (OE_i) and under-education (UE_i), respectively.⁹ Both OE_i and UE_i are mutually exclusive and take the value 1 if the worker is over- or under-educated, respectively, or 0 otherwise (i.e. if the worker is adequately educated). This VV specification can be written as follows:

$$\ln W_i = \gamma_0 + \gamma_1 S_i^a + \gamma_2 OE_i + \gamma_3 UE_i + \gamma_4 X_i + v_i \quad (2)$$

where γ_1 measures the return to an additional year of *attained* education while γ_2 and γ_3 measure the returns to being over- or under-educated, respectively. The *attained* education is hence used as the reference, so that mismatched workers are compared *directly* to workers with the *same level of education* but working in a position for which they are adequately educated. The existing literature shows that γ_2 should therefore be negative, as over-educated workers are subject to a penalty compared to their former classmates employed in jobs that match their level of education.

⁸ As in many Western European countries, collective bargaining in Belgium occurs at three levels: the national (interprofessional) level, the sectoral level, and the company level. It generally occurs every two years on a pyramidal basis. In principle, it starts with a national collective agreement defining minimum wages and a margin for wage increases that may be bargained at lower levels. Next, this national agreement is improved within every sector of activity. Sector-level agreements are concluded within Joint Committees that bring together employer and union representatives. They set industry-wide standards, including very detailed pay scales, for all workers covered by the Joint Committee. Finally, firm-level agreements can complement sector-level agreements, and set wages and working time, as well as work organization and other aspects of the working life when a union delegation is present. However, in case of diverging standards between different agreements covering the same workers, the conditions that are the most favourable to employees apply (i.e. the so-called 'favourability principle'), and firms do not have the possibility to derogate from sector-level agreement as it is the case in Germany, for instance, through so-called 'opening clauses'. Therefore, firm-level bargaining in Belgium can only improve (or confirm) the conditions set in the sectoral agreement. For more details on the collective bargaining system in Belgium, see Garnero *et al.* (2020).

⁹ Under-education may notably result from labour shortages (i.e. bottleneck vacancies) and technologically-induced changes in job content and complexity.

The second extension of the standard Mincer equation is the ORU (Over-, Required, and Under-education) specification developed by Duncan and Hoffman (1981), in which the years of attained education (S_i^a) are decomposed into years of required education (S_i^r), years of over-education (S_i^o), and years of under-education (S_i^u), using the following definition:

$$S_i^a = S_i^r + S_i^o - S_i^u \quad (3)$$

where S_i^o and S_i^u are mutually exclusive. For example, a worker with a university degree of long type (i.e. 17 years of education) employed in a job requiring a university degree of short type (i.e. 15 years of education) would have 15 years of required education (S_i^r), 2 years of over-education (S_i^o), and 0 years of under-education (S_i^u).

The ORU equation is then specified as follows:

$$\ln W_i = \delta_0 + \delta_1 S_i^o + \delta_2 S_i^r + \delta_3 S_i^u + \delta_4 X_i + w_i \quad (4)$$

where δ_1 , δ_2 , and δ_3 measure the returns to an additional year of over-, required, and under-education, respectively. Since this specification uses the *required* education level as reference, over-educated workers are compared to their co-workers who are employed in the *same occupation* but are adequately educated for this job. The existing literature suggests that: (i) the returns to required education are positive and greater than the returns to attained education (i.e. $\delta_2 > \beta_1$ and $\delta_2 > \gamma_1$), and (ii) the returns to over-education are positive but lower than the returns to required education (i.e. $\delta_1 > 0$ but $\delta_1 < \delta_2$). In other words, over-educated workers should earn a higher wage than their colleagues working in the *same occupation* but having an adequate level of education, but they should earn less than if they had worked in a job for which they have the adequate level of education.

According to Hartog (2000), the ORU specification is more accurate than the VV specification and should be preferred to the latter for two main reasons. First, the VV specification only allows to compare the wages of over-educated workers with those of their former classmates employed in jobs that match their level of education, but it does not allow to compare them with the wages of their colleagues that occupy the same position but have an adequate level of education. Moreover, it captures the over-education status of workers only through a dummy variable, which fails to take the extent of over-education (i.e. the actual number of years) into account. As a result, most of the literature on this issue focuses on the ORU rather than on the VV specification.

3.3. Investigating the role of moderating factors

To examine the role played by workers' region of birth, we first estimate the three above-mentioned models by OLS on two subsamples composed of workers born in developed and developing countries, respectively. Second, to test whether there is some heterogeneity in the returns to attained, required, and over-education among workers coming from developing countries, we re-estimate the three models on five more disaggregated subsamples, composed respectively of workers born in: i) Africa, ii) the Middle and Near East, iii) Asia, iv) Eastern Europe (non-EU), and v) Latin and Central America.

Next, using our two subsamples of workers born in developed and developing countries, respectively, we investigate the potential role played by: i) education (i.e. workers having at most upper secondary *vs.* tertiary education), ii) gender, iii) tenure (i.e. workers having less than 10 years of seniority *vs.* at least 10 years of seniority within the same firm), iv) firm size (i.e. workers working in firms employing less than 50 FTE employees *vs.* at least 50 FTE employees), and v) collective bargaining (i.e. workers working in firms that are not covered *vs.* firms that are covered by a firm-level collective agreement). To this end, we interact our education variables of interest with dummies reflecting these moderating variables. For instance, the role of gender is examined by interacting two dummies (i.e. one for females and one for males) with the numbers of years of attained education in the Mincer specification, with this latter variable and dummies for over- and under-education in the VV specification and with the numbers of years of over-, required and under-education in the ORU specification, as follows:

$$\ln W_i = \beta'_0 + \beta'_1 S_i^a D_i^f + \beta'_2 S_i^a D_i^m + \beta'_3 X_i + u_i \quad (1')$$

$$\begin{aligned} \ln W_i = \gamma'_0 + \gamma'_1 S_i^a D_i^f + \gamma'_2 S_i^a D_i^m + \gamma'_3 OE_i D_i^f + \gamma'_4 OE_i D_i^m + \gamma'_5 UE_i D_i^f \\ + \gamma'_6 UE_i D_i^m + \gamma'_7 X_i + v_i \end{aligned} \quad (2')$$

$$\begin{aligned} \ln W_i = \delta'_0 + \delta'_1 S_i^o D_i^f + \delta'_2 S_i^o D_i^m + \delta'_3 S_i^r D_i^f + \delta'_4 S_i^r D_i^m + \delta'_5 S_i^u D_i^f + \delta'_6 S_i^u D_i^m \\ + \delta'_7 X_i + w_i \end{aligned} \quad (4')$$

where D_i^f (D_i^m) is a dummy variable that is set equal to 1 if the worker i is female (male).

4. Data

Our empirical analysis is based on a combination of two large datasets covering the period 1999-2010. The first dataset is the “Structure of Earning Survey” (SES) carried out by Statistics Belgium. It covers all firms that are operating in Belgium, employ more than 10 workers, and whose economic activities fall within sections B to N of the NACE Rev. 2 nomenclature. The SES contains a wealth of information on both the characteristics of firms (e.g. sector of activity, number of employees, level of collective agreement) and those of the individuals working in these firms (e.g. gross hourly wage, education, gender, age, occupation, tenure, working time), as provided by the firms’ HR departments. Statistics Belgium has merged the SES dataset with data from the Belgian Population Register (NR) in order to provide information on each worker’s country of birth.

We restricted our sample to occupation-age-sector cells containing at least 10 observations in order to have a sufficient number of individual observations per cell when computing the required level of education. In addition, we had to discard a very small number of observations due to a lack of information on key variables. However, given the large number of observations on which our study is based, these restrictions had very little impact on the size of our sample and, hence, on its representativeness. Our final sample consists of cross-sectional data on 1,154,643 workers born in developed countries (94.5% of the overall sample) and 65,879 workers born in developing countries (5.5% of the sample), for the period 1999-2010.

[Insert Table 1 about here]

Table 1 shows that 99.4% of workers from developed countries were born in Western Europe, among which merely 95% originate from Belgium, and that more than three quarters of workers from developing countries were born in Africa and in the Middle and Near East. We further observe that around 32% of workers are women, 26.3% have a tertiary-education degree, 37.2% have been working in the same firm for at least 10 years, 45.8% are blue-collar workers, 63.9% work in medium-sized or large firms (i.e. at least 50 FTE employees), and 26.5% are covered by a firm-level collective agreement. As regards the sectors of activity, most workers are employed in manufacturing (32.8%); wholesale and retail trade, repair of motor vehicles and motorcycles (19%); transportation and storage (10.1%), and administrative and support service activities (8.7%). Statistics disaggregated by origin further show that, compared to workers born in developed countries, those born in developing countries are more likely to be men, to be lower educated, to have fewer years of tenure within the same firm, and to be employed as blue-collar workers. In

addition, they also tend to work in larger firms and to be less often covered by a firm-level collective agreement. Finally, they are concentrated more in accommodation and food service activities and in administrative and support service activities, and are far less numerous in electricity, gas, steam, and air conditioning supply and in financial and insurance activities.

[Insert Table 2 about here]

Table 2 further reports descriptive statistics on educational mismatch and wages according to workers' origin. The first column shows that workers from developing countries have on average 1 year of education less than those from developed countries and earn about 87% of the wages of the latter. Columns (2) to (4) present descriptive statistics for the samples of over-, adequately, and under-educated workers, respectively. Among workers born in developed countries, we find that 53% are adequately educated, whereas 20% are over-educated. The proportion of over-educated workers is slightly lower (18.6%) in the subsample of workers born in developing countries. At first glance, this result may seem somewhat surprising, but it follows from the fact that the level of education is lower among workers from developing countries. Indeed, workers with lower levels of education are less likely to be over-educated. Restricting our sample to workers with tertiary education, we find that the proportion of over-educated workers is, as expected, higher among workers born in developing countries (53.1% compared to 47% for those born in developed countries).

The results in Table 2 further show that the gross hourly wage varies according to whether workers are correctly matched or not. In line with the literature, we find that over-educated workers earn on average the highest wages, followed by workers with the required level of education and under-educated workers. This wage pattern is observed for both workers born in developed and developing countries. However, the average wage levels are consistently higher for workers from developed countries. By way of illustration, it can be noted that the *lowest* average wage among workers born in developed countries, namely that of the under-educated (14.5 euros), exceeds the *highest* average wage among workers born in developing countries, which is that of the over-educated (14 euros).

5. Results

5.1. Returns to attained-, required, and over-education according to workers' region of birth

Table 3 presents the results of the returns to educational mismatch estimated by OLS through the three specifications described in the methodology. First, on two subsamples of workers born in developed (column (1)) and developing countries (column (2)), respectively. Second, on more disaggregated subsamples of workers born in developing countries, depending on whether they originate from Africa (column (3)), the Middle and Near East (column (4)), Asia (column (5)), the non-EU Eastern countries (column (6)), or Latin and Central America (column (7)).

[Insert Table 3 about here]

In line with the literature, the estimates of the benchmark Mincer equation indicate that the returns to education tend to be higher for workers born in developed countries than for those born in developing countries, with each additional year of attained education yielding a return of 5.3% and 4.4%, respectively. However, this latter estimated return to education for workers from developing countries hides a substantial heterogeneity related to workers' specific region of birth, as the coefficients presented in the right-hand side of Table 3 vary from 3% for workers born in the Middle and Near East to 6.1% for those born in Latin and Central America.¹⁰

The results for the dummies specification further provide, in addition to the return to the attained-education level, the penalty incurred by over-educated workers when comparing their situation to that of their former classmates employed in jobs that match their level of education. As for the Mincer specification, the returns to attained education are lower for workers born in developing countries, particularly for those from the Middle and Near East, Eastern Europe, or Africa. Next, the estimated penalties associated with over-education for workers born in developed and developing countries amount to 9.6% and 11.3%, respectively, the latter again varying according to workers' specific region of birth. Following this specification, workers originating from Africa are found to be the most penalised by over-education, whereas the penalties are lower

¹⁰ The estimated parameters of our control variables (available upon request) are generally significant and are consistent with the results reported in the literature. In particular, regardless of the origin, we observe that women suffer from a wage penalty and that being employed in the same firm for at least 10 years increases the wage. This latter finding is compatible with the asymmetrical information on workers' true productivity, as highlighted by Allen and van der Velden (2001) and Tsai (2010). The type of contract also has an impact on wages, which are lower in the case of non-open-end contracts. Finally, wages increase with the size of the firm and in the presence of a firm-level collective agreement, which is consistent with the findings of Lallemand *et al.* (2007) and Garnero *et al.* (2020), for instance.

for those born in the Middle and Near East or in Eastern Europe. This result could be partly explained by the fact that these last two categories of workers present at the same time lower returns to attained education and lower educational levels.¹¹ Moreover, the dummy specification groups together workers with very heterogeneous levels of over-education in a single binary variable.

As regards the ORU specification, which provides more accurate estimates, it first shows that the returns to *required* education are all significantly positive. These returns follow the same pattern in terms of heterogeneity related to workers' region of birth as the returns to educational attainment obtained in the two previous specifications, although with higher values. This highlights that not only educational attainment, but to a greater extent, the educational requirements are important factors for explaining wages. The returns to an additional year of over-education are further found to be positive, which indicates that over-educated workers earn higher wages than their adequately educated co-workers employed in the *same occupation*. This return is 1.3 percentage points higher for workers born in developed countries than for their counterparts originating from developing countries, with the lowest returns still being obtained for workers coming from the Middle and Near East, Africa, and Eastern Europe. These workers are thus those who benefit the least from their investment in education, as they present lower returns to both required- and over-education. In addition, although the returns to an additional year of over-education are positive, they only represent 55% (41%) of the returns to required education for workers born in developed (developing) countries, as shown by the variable 'Ratio OE/RE' at the bottom of Table 3. In other words, over-educated workers would have perceived higher wages if they had occupied a position matching their education level. Given that the ratio of the return to over-education to the return to required education is lower for workers from developing countries, they are those who suffer the most from over-education, the penalties being particularly pronounced for workers coming from the Middle and Near East or from Africa.¹²

¹¹ The mean educational attainment is 11.8 years for workers coming from developed countries, compared to 9.8 years for those coming from the Middle and Near East, 10.6 years for those coming from Eastern Europe, 10.7 for those coming from Africa, 11.6 years for those coming from Asia, and 12.1 years for those coming from Latin and Central America.

¹² In Appendix 2, we further rely on the Oaxaca-Blinder (1973) method to decompose the developed-developing wage gap into two parts: a part explained by differences in observable productive characteristics and a part that can be attributed to differences in returns to those characteristics (i.e. the so-called 'unexplained' part). We run this decomposition on the subsamples of adequately educated workers (column (1) of Appendix 2) and of over-educated workers (column (2)), respectively. Regarding the sample of workers with the adequate level of education, the results show that differences in returns to observable characteristics account for slightly less than a third (i.e. 29%) of the overall wage gap. In contrast, when taking the sample of over-educated workers into account, the unexplained part amounts to 53%. Although not all variables reflecting workers' productivity could be included in our regression (information on knowledge of languages is notably missing), these results suggest that wage discrimination on the basis of origin is more prevalent among over-educated workers than among workers with the required level of education for their job.

5.2. The role of education, gender, and tenure

We further examine the potential moderating role of education, gender, and tenure in the relationship between educational mismatch and wages according to workers' origin. Table 4 therefore displays the results obtained with the Mincer and the ORU specifications,¹³ on the two subsamples of workers coming from developed and developing countries, respectively, in which we have interacted our variables related to (attained-, required, over-, and under-) education with dummies reflecting these moderating variables, namely workers' i) highest attained level of education (at most upper secondary *vs.* tertiary education) in columns (1) and (2), ii) gender (female *vs.* male) in columns (3) and (4), and iii) tenure (having less than *vs.* at least 10 years of seniority within the same firm) in columns (5) and (6).

[Insert Table 4 about here]

The results related to the Mincer specification, presented in the upper part of Table 4, again first show that, at a given level of education, gender or tenure, the returns to attained education are higher for workers born in developed countries than for those born in developing countries.

Then, focusing on the moderating role of education (columns (1) and (2)), we find that tertiary-educated workers enjoy, as expected, larger returns to attained education than workers who have at most a degree from upper secondary education, regardless of their origin. Having a tertiary diploma is further found to reduce the gap in the wage return to attained education between workers born in developed and developing countries.

Turning to the ORU estimates, the returns to required education follow the same pattern as those for attained education, though with higher values. As regards over-education, the returns are found, *ceteris paribus*, to be larger for workers born in developed countries and for the lower educated. The conclusion for tertiary educated workers coming from developing countries is mixed. For those who are able to find a job matching their education and that are thus not confronted with a problem of degree recognition, the returns to their educational credentials appear to be quite good, i.e. close to those of their counterparts born in developed countries. The estimates in columns (1) and (2) of Table 4 indeed show that the returns to

¹³ Because the estimates of the dummy specification are less precise, and for the sake of conciseness, in the remainder of this paper we will directly focus on results obtained with the Mincer and ORU specifications. However, the estimates of the dummy specification are reported in Appendices 3 and 4. Overall, they corroborate our main conclusions.

required education are very similar for workers with tertiary education born respectively in developed and developing countries (6.4 vs. 5.8%). However, for those who find themselves in jobs for which they are over-educated (and who have therefore not been able to have their degrees or certificates properly recognised), the situation is much worse. As column (2) of Table 4 shows, the return to their years of over-education is actually negative. This can be explained by the fact that tertiary-educated people from developing countries who have not obtained an equivalence statement for their diploma or certificate are forced to look for low-skilled jobs (e.g. in construction, transport, or cleaning). Although these jobs are low-skilled, it is likely that these people lack the competences, experience and/or motivation to perform them in the best way and are therefore less productive (and paid less) in these jobs than their low-skilled counterparts (who are likely to have had at least some training and/or experience in these fields of work).

Finally, the results in columns (1) and (2) of Table 4 show that the returns to years of required education are systematically larger than those to years of over-education. This implies that, irrespective of their origin and level of education, over-educated workers earn less than they could have in a job matching their education level. As the "OE/RE ratio" variable at the bottom of Table 4 shows, this over-education wage penalty is highest among tertiary educated workers and in particular among those born in developing countries.¹⁴

As for the moderating role of gender (columns (3) and (4)), although the returns to both attained (i.e. Mincer specification) and required (i.e. ORU specification) education are larger for male than for female workers regardless of their origin, the moderating role of gender in the relationship between over-education and wages is found to depend on workers' origin. Among workers born in developed countries, we find that the return to an additional year of over-education is almost identical for women and men (around 4%). In contrast, for those born in developing countries, the return is somewhat higher for women than for men (3.7% vs. 2.6%).¹⁵ Finally, if we compare the returns to over- and required education by gender and origin, we can conclude (on the basis of the 'OE/RE ratio' variable) that over-educated workers suffer a wage penalty, which turns out to be more pronounced for men than for women¹⁶ and especially for men from developing countries. Therefore, our results do not support the hypothesis that the wage penalty associated with over-education is double for women from developing countries.

¹⁴ The 'OE/RE ratio' variable measures the ratio of the return to over- and required education, respectively. Therefore, the smaller the value of this variable, the larger the over-education wage penalty.

¹⁵ However, these results should be taken with caution as over-educated female workers born in developing countries only represent 5% of the sample of workers originating from these countries.

¹⁶ This outcome is consistent with the results obtained by Daly *et al.* (2000) and Ren and Miller (2011).

Rather, based on the OE/RE ratio, we would conclude that the over-education wage penalty for women from developing countries is close to that of women from developed countries (the OE/RE ratios being equal to 0.57 and 0.60, respectively).

Regarding our last demographic moderating variable, we first find that the returns to attained and required education increase with workers' years of tenure, irrespective of whether they originate from developed (column (5)) or developing (column (6)) countries. Furthermore, we observe that the gap in returns to required education according to workers' origin almost disappears as years of tenure increase. Indeed, for workers with at least 10 years of tenure, the return to required education reaches 8.6% and 8.5% for workers born in developed and developing countries, respectively.

As for the return to an additional year of over-education, it is found to be positive, somewhat higher among workers born in developed countries, and to increase similarly with the number of years of tenure for both categories of workers. This outcome is partly compatible with the statistical discrimination story. According to this theory the information available to the employer about a worker's true productivity increases with the length of the employment relationship, so that problems of asymmetric information (which may penalise over-educated workers and in particular those from developing countries) should be inversely correlated with years of tenure. So, although the increasing return to over-education as a function of tenure appears to be in line with the statistical discrimination story, the persistent gap in returns to over-education among more tenured workers born in developed and developing countries is less consistent with this theory.

Finally, comparing the returns to required and over-education, we find that over-educated workers suffer a wage penalty (with respect to what they could have earned had they been well matched), irrespective of their origin and years of tenure. However, the results also show that this penalty: i) is greater for workers born in developing countries, ii) increases with workers' years of tenure, and iii) is most pronounced for high-tenured workers from developing countries. This outcome is also difficult to reconcile with the predictions of the statistical discrimination story, according to which the over-education wage penalty should decrease with tenure, especially among immigrants from developing countries. In fact, our findings rather seem to reflect the fact that, as tenure increases, the loss suffered by over-educated workers (especially those born in developing countries) increases relative to what they could have earned in a job corresponding to their qualification, a result that follows simply from the fact that, in Belgium, white-collar jobs are much more likely to be paid according to seniority than blue-collar jobs (which are typically occupied by

lower educated workers) and seniority-pay profiles are generally much steeper for high- than for low-skilled white-collar jobs (Kampelmann *et al.*, 2018).

5.3. The role of firm characteristics

Table 5 presents the results regarding the moderating role of firm size and firm-level collective agreements in the relationship between educational mismatch and wages according to workers' origin. Following the same methodology as in the previous section, we have interacted the variables related to (attained-, required, over-, and under-) education with dummies reflecting: i) the size of the firm (i.e. whether the worker is employed in a firm with less than vs. at least 50 FTE employees) in columns (1) and (2), and ii) whether or not the worker is covered by a firm-level collective agreement, in columns (3) and (4). Again, we directly focus on results obtained with the Mincer and ORU specifications, with the estimates of the dummy specification reported in Appendix 4.¹⁷

[Insert Table 5 about here]

The results first show that, in both small and large firms, the returns to attained, required, and over-education remain higher for workers born in developed countries (column (1)) than for those born in developing countries (column (2)). Regardless of firm size and workers' origin, we also find, as expected, that the returns to required education consistently exceed those to attained education and over-education. In addition, although the three types of returns are found to increase with firm size, differences in these returns for workers born in developed and developing countries remain almost unaffected by firm size. Finally, the OE/RE ratios (reported at the bottom of columns (1) and (2)) highlight that the over-education wage penalty: i) is higher for workers born in developing countries, ii) decreases with firm size, and iii) is most pronounced for workers from developing countries employed in small firms.

Overall, these findings are consistent with the assumption that larger firms have more transparent and efficient human resources management practices, particularly in terms of evaluation, promotion, and compensation (Lallemand and Rycx, 2006; Lallemand *et al.*, 2007; Cornelissen and Jirahn, 2012), which would not only better reward investments in education, but also (somewhat) limit possible wage discrimination practices.

¹⁷ Overall, results obtained with the dummy specification are quite consistent with those presented in this section.

Looking at columns (3) and (4), we find that our benchmark finding, according to which workers born in developed countries enjoy better returns to (attained, required, and over-) education than their opposite numbers from developing countries, is valid regardless of whether or not workers are covered by a firm-level collective agreement. Moreover, whereas returns to attained and required education are found to increase quite similarly for both categories of workers covered by a firm level collective agreement, the opposite result (albeit of limited size) is obtained for returns to over-education. We thus find that the differences in the returns to attained, required, and over-education according to workers' origin depend very little on the type of collective agreement that prevails. Finally, given that the returns to required education are consistently higher than those to over-education, the results again indicate that over-educated workers suffer a wage penalty. However, as shown by the OE/RE ratios, the magnitude of this penalty is quite heterogeneous: i) it affects workers from developing countries more severely, and ii) it is somewhat greater in the presence of a firm-level collective agreement. However, given that the effects associated with origin and collective bargaining seem to add up, the over-education wage penalty is found to be the largest for workers born in developing countries and covered by a firm-level agreement.

In sum, this analysis suggests that trade unions enable workers, regardless of their origin, to enjoy a greater return on their investment in education, provided that such workers are employed in jobs for which they are adequately educated. In contrast, the return to over-education does not seem to be a priority for unions. Yet, Jacobs *et al.* (2021) previously found that firm-level collective agreements were associated with significantly improved education-job matches in Belgium, especially for immigrants from developing countries. It may therefore be that trade unions prefer prevention over cure when it comes to dealing with over-education.

6. Discussion and conclusion

Foreign-born people account for 17% of the total population in Belgium. This makes Belgium one of the most multicultural country in the OECD. At the same time, Belgium is often depicted as one of the worst OECD countries in terms of employment outcomes for immigrants (OECD, 2019). This is notably illustrated by the employment rate of immigrants born in developing countries, which reaches no more than 50%. This critical situation is also reflected in foreign-born workers' working conditions, such as lower wages (e.g. Kampelmann and Rycx, 2016) and/or a higher probability of being over-educated (e.g. Jacobs *et al.*, 2021), compared to their native counterparts.

This paper is the first attempt to examine the relationship between educational mismatch and wages in Belgium according to workers' origin. In addition, it contributes to the growing

empirical literature devoted to this relationship in two complementary ways. First, by using a sizeable, detailed matched employer-employee dataset, covering the Belgian private sector over more than a decade, we rely on a more fine-grained realized matches approach than the one generally used in the literature. Our approach enables us to measure education requirements and over-education while controlling for cohort effects and for the fact that the requirements for a given occupation are very likely to differ across sectors. More specifically, we estimate the required levels of education for jobs by taking the mode of the education levels in more than 5,400 occupational/age/industry cells.

Second, despite the growing number of studies comparing the wage penalties associated with over-education for natives and immigrants, very little is known on whether and how moderating factors might influence these earnings' differentials. Accordingly, our paper aims to fill this gap by investigating the role played by demographics and firm characteristics. More precisely, our study is one of the first to take explicit account of the heterogeneity of immigrants in terms of region of birth (i.e. to go beyond the traditional 'native vs. immigrant' approach), as this heterogeneity has been shown to influence the transferability of human capital (Ramos *et al.*, 2015), workers' likelihood of being over-educated (Jacobs *et al.*, 2021), and the extent of wage discrimination (Fays *et al.*, 2021). Our paper also contributes to the existing literature by investigating the role played by gender and education, two moderating variables that have so far received little attention. Finally, we also examined whether tenure (i.e. the number of years an employee has worked for her/his current employer), firm size, and firm-level collective agreements similarly affect the over-education wage penalty for workers originating from different regions. To our knowledge, the role of these moderating variables has not been explored in this context before.

The estimates from our regressions, based respectively on the Mincer (1974), Verdugo and Verdugo (1989), and Duncan and Hoffman (1981) specifications, first highlight that the returns to (attained-, required, and over-) education are significantly higher for workers born in developed countries than for those born in developing countries. In addition to having lower educational credentials on average, workers from developing countries are thus also found to benefit less from their investments in education. These results can be explained, at least in part, by the problem of transferability of human capital that particularly affects people from developing countries. However, wage discrimination on the basis of origin is also likely to be part of the explanation, as an Oaxaca-Blinder (1973) decomposition shows that, although this issue is prevalent among both over- and adequately educated workers, it is more acute among the former.

Second, our results show that the wage return to a year of over-education is positive but lower than that for a year of required education. This implies that over-educated workers suffer a wage penalty compared to their well-matched former classmates (i.e. workers with the same level of education employed in jobs matching their education level). However, the magnitude of this wage penalty is found to vary considerably according to workers' origin. Indeed, all else being equal, the estimates show that the penalty is much greater for workers from developing countries, and in particular for those born in Africa or in the Middle and Near East, than for those from developed countries. These estimates are consistent with previous studies focusing on the Belgian labour market, which have shown that among people of foreign origin, those from the Near and Middle East and from Africa are especially penalised in terms of access to employment (Ryck and Piton, 2021), likelihood of being over-educated (Jacobs *et al.*, 2021), and wage discrimination (Fays *et al.*, 2021).

Regardless of workers' origin, our estimates further indicate that the wage penalty associated with over-education is higher for workers who: i) are tertiary educated, ii) are male, iii) have more seniority in employment, iv) are employed in smaller firms, and v) are covered by a company collective agreement. Yet, they also show that, whatever the considered moderating variable, the wage penalty associated with over-education remains higher for workers born in developing countries.

More specifically, focusing on the role of education, we find that the over-education wage penalty is the highest among tertiary educated workers born in developing countries. This finding, which is in line with Kler (2007) and Chiswick and Miller (2009b), could be illustrated, for example, by the case of an immigrant from Syria who has obtained a master's degree in law in her/his home country but is not able to have it recognized in Belgium. Accordingly, she/he may be forced to apply for a low-skilled job such as builder, cleaner, or truckdriver, that is, for a job for which she/he will not be very competent, experienced, and/or motivated. This will, in turn, generate a substantial over-education wage penalty, i.e. a substantial wage gap with respect to what she/he could have earned if she/he had been well matched. This is especially true because our results also show that higher educated workers from developing countries who are able to find a job matching their education and are thus not confronted with a problem of degree recognition have almost similar returns to their degrees than higher educated workers from developed countries.

Next, regarding the moderating role of gender, our results suggest that the over-education wage penalty is more pronounced for men than for women, and especially for men from developing countries. Therefore, we do not support the hypothesis of a double over-

education wage penalty for women from developing countries. We rather conclude that the over-education wage penalty for women from developing countries is closer to that of women from developed countries. Regarding the role of tenure, our results highlight that the loss experienced by over-educated workers, particularly those born in developing countries, compared to what they could have earned had they been well-matched, increases with the number of years spent with their current employer. This finding, which is difficult to reconcile with the predictions of the statistical discrimination theory, most likely follows from the fact that, in Belgium, high-skilled jobs are characterised by pay scales that provide for significantly higher pay increases with seniority than lower-skilled jobs (Kampelmann *et al.*, 2018).

Finally, regarding the role of firm characteristics, the results suggest, on the one hand, that the wage penalty associated with over-education is higher in smaller firms, especially for workers from developing countries. This result supports the hypothesis of less transparent and effective HRM practices in small firms, particularly in terms of evaluation, promotion, and compensation (Lallemand and Rycx, 2006; Lallemand *et al.*, 2007; Cornelissen and Jirahn, 2012), which would reduce the returns to education in these firms and potentially foster origin-based discriminatory behaviours. On the other hand, our estimates suggest that firm-level agreements foster workers' returns to education, regardless of their origin, provided that the workers occupy jobs matching their education level. In contrast, the wage penalty associated with over-education appears to be less of an issue for unions. Indeed, our results suggest that the effects associated with origin and collective bargaining add up, so that the wage penalty associated with over-education turns out to be the highest for workers born in developing countries and covered by a firm-level collective agreement. Given that Jacobs *et al.* (2021) found that the probability of workers of being over-educated in Belgium is lower in the presence of a firm-level collective agreement, especially for immigrants born in developing countries, our results suggest that trade unions prefer prevention over cure when dealing with over-education.

In light of these results and as a final conclusion, a few policy recommendations and remarks can be formulated. First, significant efforts should probably still be made to improve and facilitate the current procedures for the recognition of diplomas and certificates obtained by immigrants in their home countries. As pointed out by the OECD (2017), part of the strategy to achieve this goal includes the right for all immigrants to have their qualifications (including their prior labour market experience) assessed rapidly by an official authority, ideally prior to their arrival in the host country. Fast recognition procedures are beneficial for employers who may want to fill shortages (e.g. bottleneck vacancies) quickly. They are also appreciated by

immigrants because these procedures are likely to improve employers' information about their true human capital and productive capacity, which in turn should reduce statistical discrimination. In addition, through the recognition of their qualifications, immigrants should be able to increase the return on their investments in education by deploying their skill potential, i.e. by finding jobs better suited to their skills. Second, to fight monopsonistic discrimination, immigrants' knowledge of the host country's labour market characteristics probably also needs to be improved, especially regarding the typical educational requirements for different types of jobs and the associated minimum working conditions. To compensate, at least in part, for the fact that their networks are generally less effective than those of the native-born, immigrants should also be better informed about all possible job opportunities that match their skills and about vocational training programmes, notably offered by public employment services, that could improve their occupational mobility. Finally, given that workers born in developing countries face higher wage penalties associated with over-education, it is worth noting that policies aimed at improving the match between the demand and supply of skills in the labour market are also likely to help reduce the overall wage gap between workers born in developed and those born in developing countries.

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Table 1. Descriptive statistics on worker and firm characteristics, 1999–2010

Variables:	<i>Subsample of workers born in:</i>		
	Overall sample (1)	Developed countries (2)	Developing countries (3)
Worker characteristics (%):			
Region of birth:			
Developed countries:	94.5		
Western Europe		99.4	
<i>Among which Belgium</i>		94.9	
Eastern Europe (EU)		0.4	
North America and South Pacific		0.1	
Japan		0.0	
Developing countries:	5.5		
Africa			58.6
Middle and Near East			18.4
Asia			9.6
Eastern Europe (non-EU)			9.0
Latin and Central America			4.3
Women	32.1	32.4	26.7
Education:			
At most upper secondary	73.7	73.2	82.6
Tertiary	26.3	26.8	17.4
Tenure ≥ 10 years	37.2	38.3	19.2
Blue collar	45.8	44.8	63.2
Age categories:			
15-29	23.1	23.3	21.2
30-49	59.2	58.7	67.3
50+	17.7	18.1	11.5
Firm characteristics (%):			
Size of the firm (FTE number of employees):			
Small (10-49)	35.8	35.9	32.8
Medium and large (50+)	63.9	63.7	66.7
Firm-level collective agreement	26.5	26.7	22.2
Sector of activity:			
Mining and quarrying (B)	0.2	0.2	0.1
Manufacturing (C)	32.8	33.1	26.9
Electricity, gas, steam, and air conditioning supply (D)	1.0	1.0	0.3
Water supply, sewerage, waste management and remediation activities (E)	0.4	0.4	0.4
Construction (F)	7.9	7.9	8.9
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	19.0	19.3	13.7
Transportation and storage (H)	10.1	10.1	9.9
Accommodation and food service activities (I)	3.5	3.1	10.4
Information and communication (J)	4.3	4.4	3.1
Financial and insurance activities (K)	7.0	7.2	3.7
Real estate activities (L)	0.3	0.3	0.2
Professional, scientific, and technical activities (M)	4.8	4.8	4.0
Administrative and support service activities (N)	8.7	8.2	18.5
Share of sample (%)	100.0	94.5	5.5
Number of observations	1,220,522	1,154,643	65,879

Notes: The subdivision between developed and developing countries is based on United Nations' (2020) classification. 'Developing countries' include both transition and developing countries which are listed in this classification (see Appendix 1 for more details).

Table 2. Descriptive statistics by educational (mis)match

	Total (1)	Over- educated (2)	Adequately educated (3)	Under- educated (4)
Developed countries				
Observations	1,154,643	236,474	610,554	307,615
(%)	(100)	(20.0)	(53.0)	(26.9)
Years of attained education	11.8	14.3	12.2	9.3
Gross hourly wage (€) ^a	15.1	15.8	15.1	14.5
Developing countries				
Observations	65,879	12,063	31,199	22,617
(%)	(100)	(18.6)	(47.2)	(34.2)
Years of attained education	10.7	13.9	11.4	7.9
Gross hourly wage (€) ^a	13.1	14.0	13.3	12.4

Notes: The subdivision between developed and developing countries is based on United Nations' (2020) classification. 'Developing countries' include both transition and developing countries which are listed in this classification (see Appendix 1 for more details).^a At 2004 constant prices.

Table 3. Returns to attained, required and over-education according to workers' region of birth

Dependant variable: log of hourly wage	Developed countries (1)	Developing countries (2)	Africa (3)	Middle and Near East (4)	Asia (5)	Eastern Europe (non-EU) (6)	Latin and Central America (7)
i) Mincer specification							
Attained education (years)	0.053*** (0.000)	0.044*** (0.001)	0.045*** (0.001)	0.030*** (0.001)	0.053*** (0.002)	0.039*** (0.002)	0.061*** (0.002)
Adjusted R ²	0.415	0.380	0.383	0.292	0.464	0.371	0.500
Sig. Model (<i>p</i> -value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ii) Dummies specification							
Over-education (dummy)	-0.096*** (0.001)	-0.113*** (0.004)	-0.123*** (0.005)	-0.086*** (0.009)	-0.108*** (0.012)	-0.092*** (0.014)	-0.097*** (0.018)
Attained education (years)	0.071*** (0.000)	0.066*** (0.001)	0.067*** (0.001)	0.050*** (0.002)	0.073*** (0.002)	0.058*** (0.003)	0.079*** (0.003)
Under-education (dummy)	0.164*** (0.001)	0.173*** (0.004)	0.177*** (0.005)	0.134*** (0.008)	0.187*** (0.011)	0.143*** (0.010)	0.163*** (0.016)
Adjusted R ²	0.458	0.437	0.443	0.332	0.517	0.415	0.530
Sig. Model (<i>p</i> -value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
iii) ORU specification							
Over-education (years)	0.042*** (0.000)	0.029*** (0.001)	0.028*** (0.002)	0.021*** (0.002)	0.039*** (0.003)	0.028*** (0.003)	0.038*** (0.005)
Required education (years)	0.076*** (0.000)	0.071*** (0.001)	0.072*** (0.001)	0.056*** (0.002)	0.079*** (0.002)	0.064*** (0.003)	0.084*** (0.003)
Under-education (years)	-0.022*** (0.000)	-0.021*** (0.001)	-0.021*** (0.001)	-0.018*** (0.001)	-0.021*** (0.002)	-0.021*** (0.002)	-0.032*** (0.003)
Ratio OE/RE	0.55	0.41	0.39	0.38	0.49	0.44	0.45
Adjusted R ²	0.472	0.458	0.464	0.353	0.543	0.435	0.556
Sig. Model (<i>p</i> -value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	1,154,643	65,879	38,703	11,841	6,287	6,017	3,031

Notes: Each model includes control variables for gender, tenure, part-time, contract (four categories), region of the establishment (three categories), size of the establishment (three categories), state ownership, firm agreement, birth regions (three dummies for the subsample of workers born in developed countries (column 1)) and four dummies for the subsample of workers born in developing countries (column 2)) – columns (3) to (7) do not include dummies for birth regions), and eleven year dummies. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4. Returns to attained, required and over-education – The role of education, gender, and tenure

The moderating role of education			The moderating role of gender			The moderating role of tenure		
Dependant variable: log of hourly wage	Developed countries (1)	Developing countries (2)		Developed countries (3)	Developing countries (4)		Developed countries (5)	Developing countries (6)
i) Mincer specification			i) Mincer specification			i) Mincer specification		
Attained education (years) & at most upper secondary education	0.025*** (0.000)	0.014*** (0.001)	Attained education (years) & female workers	0.044*** (0.000)	0.039*** (0.001)	Attained education (years) & tenure < 10 years	0.047*** (0.000)	0.040*** (0.001)
tertiary education	0.040*** (0.000)	0.036*** (0.000)	male workers	0.057*** (0.000)	0.046*** (0.001)	tenure ≥ 10 years	0.063*** (0.000)	0.058*** (0.001)
Adjusted R ²	0.445	0.449	Adjusted R ²	0.414	0.377	Adjusted R ²	0.416	0.385
Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000
ii) ORU specification			ii) ORU specification			ii) ORU specification		
Over-education (years) & at most upper secondary education	0.025*** (0.000)	0.013*** (0.001)	Over-education (years) & female workers	0.040*** (0.000)	0.037*** (0.002)	Over-education (years) & tenure < 10 years	0.040*** (0.000)	0.028*** (0.001)
tertiary education	0.013*** (0.000)	-0.017*** (0.002)	male workers	0.042*** (0.000)	0.026*** (0.001)	tenure ≥ 10 years	0.044*** (0.000)	0.032*** (0.003)
Required education (years) & at most upper secondary education	0.051*** (0.000)	0.034*** (0.001)	Required education (years) & female workers	0.067*** (0.000)	0.065*** (0.001)	Required education (years) & tenure < 10 years	0.070*** (0.000)	0.067*** (0.001)
tertiary education	0.064*** (0.000)	0.058*** (0.001)	male workers	0.080*** (0.000)	0.074*** (0.001)	tenure ≥ 10 years	0.086*** (0.000)	0.085*** (0.001)
Under-education (years) & at most upper secondary education	-0.010*** (0.000)	-0.006*** (0.001)	Under-education (years) & female workers	-0.022*** (0.000)	-0.023*** (0.001)	Under-education (years) & tenure < 10 years	-0.020*** (0.000)	-0.020*** (0.001)
tertiary education	-0.042*** (0.001)	-0.059*** (0.007)	male workers	-0.022*** (0.000)	-0.021*** (0.001)	tenure ≥ 10 years	-0.026*** (0.000)	-0.024*** (0.002)
Ratio OE/RE at most upper secondary education	0.49	0.38	Ratio OE/RE female workers	0.60	0.57	Ratio OE/RE among workers with < 10 years of tenure	0.57	0.42
Ratio OE/RE tertiary education	0.20	-0.29	Ratio OE/RE male workers	0.53	0.35	Ratio OE/RE among workers with ≥ 10 years of tenure	0.51	0.38
Adjusted R ²	0.487	0.507	Adjusted R ²	0.471	0.459	Adjusted R ²	0.474	0.462
Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000
Observations	1,154,643	65,879	Observations	1,154,643	65,879	Observations	1,154,643	65,879

Notes: Each model includes control variables for gender, tenure, part-time, contract (four categories), region of the establishment (three categories), size of the establishment (three categories), state ownership, firm agreement, birth regions (three dummies for the subsample of workers born in developed countries and four dummies for the subsample of workers born in developing countries), and eleven year dummies. Standard errors in parentheses. *** *p*<0.01, ** *p*<0.05, * *p*<0.1.

Table 5. Returns to attained, required and over-education – The role of firm characteristics

The moderating role of firm size			The moderating role of firm-level collective agreements		
Dependant variable: log of hourly wage	Developed countries (1)	Developing countries (2)		Developed countries (3)	Developing countries (4)
i) Mincer specification			i) Mincer specification		
Attained education (years) & firm size < 50 FTE employees	0.048*** (0.000)	0.038*** (0.001)	Attained education (years) & no firm-level collective agreement	0.052*** (0.000)	0.043*** (0.001)
firm size ≥ 50 FTE employees	0.056*** (0.000)	0.047*** (0.001)	firm-level collective agreement	0.056*** (0.000)	0.048*** (0.001)
Adjusted R ²	0.411	0.374	Adjusted R ²	0.415	0.380
Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000
ii) ORU specification			ii) ORU specification		
Over-education (years) & firm size < 50 FTE employees	0.038*** (0.000)	0.025*** (0.001)	Over-education (years) & no firm-level collective agreement	0.042*** (0.000)	0.029*** (0.001)
firm size ≥ 50 FTE employees	0.044*** (0.000)	0.030*** (0.001)	firm-level collective agreement	0.041*** (0.000)	0.027*** (0.002)
Required education (years) & firm size < 50 FTE employees	0.072*** (0.000)	0.065*** (0.001)	Required education (years) & no firm-level collective agreement	0.075*** (0.000)	0.070*** (0.001)
firm size ≥ 50 FTE employees	0.079*** (0.000)	0.072*** (0.001)	firm-level collective agreement	0.078*** (0.000)	0.075*** (0.001)
Under-education (years) & firm size < 50 FTE employees	-0.023*** (0.000)	-0.021*** (0.001)	Under-education (years) & no firm-level collective agreement	-0.023*** (0.000)	-0.023*** (0.001)
firm size ≥ 50 FTE employees	-0.022*** (0.000)	-0.020*** (0.001)	firm-level collective agreement	-0.020*** (0.000)	-0.015*** (0.002)
Ratio OE/RE < 50 FTE employees	0.53	0.38	Ratio OE/RE without firm agreement	0.56	0.41
Ratio OE/RE ≥ 50 FTE employees	0.56	0.42	Ratio OE/RE with firm agreement	0.53	0.36
Adjusted R ²	0.469	0.454	Adjusted R ²	0.472	0.462
Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000
Observations	1,154,643	65,879	Observations	1,154,643	65,879

Notes: Each model includes control variables for gender, tenure, part-time, contract (four categories), region of the establishment (three categories), size of the establishment (three categories), state ownership, firm agreement, birth regions (three dummies for the subsample of workers born in developed countries and four dummies for the subsample of workers born in developing countries), and eleven year dummies. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix 1: Description of country categories (based on UNCTAD, 2020)

a) Developed countries

Western Europe: Andorra, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Monaco, the Netherlands, Norway, Portugal, San Marino, Spain, Sweden, Switzerland, and the United Kingdom.

Eastern Europe (EU-13): Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, and Romania.

North America and South Pacific: Australia, Canada, French Polynesia, Hawaii, New Zealand, New Caledonia, Papua New Guinea, Tahiti, the United States of America, and Wallis and Futuna.

Japan: Japan

b) Developing countries

Africa: Algeria, Angola, Burundi, Cameroon, Cote d'Ivoire, Democratic Republic of the Congo, Ghana, Libya, Mauritania, Morocco, Nigeria, Rwanda, Senegal, South Africa, Togo, etc.

The Middle and Near East: Afghanistan, Brunei Darussalam, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Palestine, Saudi Arabia, Syria, Turkey, the United Arab Emirates, and Yemen.

Asia: Bangladesh, Cambodia, China, India, Indonesia, Japan, Laos, Philippines, South Korea, Taiwan, Thailand, Vietnam, etc.

Eastern Europe (non-EU): Albania, Armenia, Kazakhstan, Kosovo, Russia, and Serbia.

Latin and Central America: Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, the Dominican Republic, Ecuador, Guatemala, Mexico, Nicaragua, Peru, Venezuela, etc.

Note: by developing countries, we actually refer to both transition and developing countries listed in the UNCTAD (2020) classification.

Appendix 2. Oaxaca-Blinder wage decompositions

	Adequately educated workers (1)	Over-educated workers (2)
Explained component	0.086*** (0.002)	0.057*** (0.003)
Unexplained component	0.034*** (0.002)	0.064*** (0.003)
Wage (in log) gap	0.119*** (0.003)	0.120*** (0.005)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix 3. Returns to attained, required and over-education – dummies specification: The role of demographics

The moderating role of education			The moderating role of gender			The moderating role of tenure		
Dependant variable: log of hourly wage	Developed countries (1)	Developing countries (2)		Developed countries (3)	Developing countries (4)		Developed countries (5)	Developing countries (6)
Over-education (dummy) & at most upper secondary education	-0.082*** (0.001)	-0.061*** (0.004)	Over-education (dummy) & female workers	-0.071*** (0.002)	-0.072*** (0.007)	Over-education (dummy) & tenure < 10 years	-0.080*** (0.001)	-0.104*** (0.005)
tertiary education	-0.162*** (0.002)	-0.265*** (0.009)	male workers	-0.105*** (0.001)	-0.129*** (0.005)	tenure ≥ 10 years	-0.122*** (0.002)	-0.145*** (0.009)
Attained education (years) & at most upper secondary education	0.045*** (0.000)	0.030*** (0.001)	Attained education (years) & female workers	0.062*** (0.000)	0.060*** (0.001)	Attained education (years) & tenure < 10 years	0.065*** (0.000)	0.062*** (0.001)
tertiary education	0.060*** (0.000)	0.056*** (0.001)	male workers	0.075*** (0.000)	0.068*** (0.001)	tenure ≥ 10 years	0.081*** (0.000)	0.080*** (0.001)
Under-education (dummy) & at most upper secondary education	0.124*** (0.001)	0.094*** (0.004)	Under-education (dummy) & female workers	0.131*** (0.001)	0.142*** (0.005)	Under-education (dummy) & tenure < 10 years	0.149*** (0.001)	0.163*** (0.004)
tertiary education	0.040*** (0.003)	-0.007 (0.015)	male workers	0.177*** (0.001)	0.184*** (0.004)	tenure ≥ 10 years	0.186*** (0.001)	0.206*** (0.006)
Adjusted R ²	0.476	0.490	Adjusted R ²	0.457	0.437	Adjusted R ²	0.459	0.442
Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000	0.000
Observations	1,154,643	65,879	Observations	1,154,643	65,879	Observations	1,154,643	65,879

Notes: Each model includes control variables for gender, tenure, part-time, contract (four categories), region of the establishment (three categories), size of the establishment (three categories), state ownership, firm agreement, birth regions (three dummies for the subsample of workers born in developed countries and four dummies for the subsample of workers born in developing countries), and eleven year dummies.

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix 4. Returns to attained, required and over-education – dummies specification: The role of firm characteristics

Dependant variable: log of hourly wage	The moderating role of firm size		The moderating role of firm-level collective agreements	
	Developed countries (1)	Developing countries (2)	Developed countries (3)	Developing countries (4)
Over-education (dummy) & firm size < 50 FTE employees	-0.093*** (0.002)	-0.110*** (0.007)	Over-education (dummy) & no firm-level collective agreement -0.093*** (0.001)	-0.111*** (0.005)
firm size ≥ 50 FTE employees	-0.098*** (0.001)	-0.110*** (0.005)	firm-level collective agreement -0.104*** (0.002)	-0.121*** (0.009)
Attained education (years) & firm size < 50 FTE employees	0.066*** (0.000)	0.059*** (0.001)	Attained education (years) & no firm-level collective agreement 0.070*** (0.000)	0.065*** (0.001)
firm size ≥ 50 FTE employees	0.074*** (0.000)	0.067*** (0.001)	firm-level collective agreement 0.073*** (0.000)	0.069*** (0.001)
Under-education (dummy) & firm size < 50 FTE employees	0.149*** (0.001)	0.146*** (0.005)	Under-education (dummy) & no firm-level collective agreement 0.160*** (0.001)	0.163*** (0.004)
firm size ≥ 50 FTE employees	0.174*** (0.001)	0.182*** (0.004)	firm-level collective agreement 0.177*** (0.002)	0.208*** (0.006)
Adjusted R ²	0.454	0.432	Adjusted R ²	0.458
Sig. Model (<i>p</i> -value)	0.000	0.000	Sig. Model (<i>p</i> -value)	0.000
Observations	1,154,643	65,879	Observations	1,154,643

Notes: Each model includes control variables for gender, tenure, part-time, contract (four categories), region of the establishment (three categories), size of the establishment (three categories), state ownership, firm agreement, birth regions (three dummies for the subsample of workers born in developed countries and four dummies for the subsample of workers born in developing countries), and eleven year dummies.

Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.