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L'UNION FAIT LA FORCE? EVIDENCE FOR WAGE DEPRESSION IN FIRMS WITH HIGH DIVERSITY

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Abstract

Measuring the economic impact of co-workers from different countries of origin has sparked intense scrutiny in labour economics, albeit with an uncomfortable methodological limitation: most attempts at measuring the impact of diversity – and at measuring diversity itself – have involved metrics that eliminate most of the economically relevant distances between different countries of origin. The typical example of such metrics are diversity indicators that divide the firm's workforce into black and white, foreign and native, European and non European, etc. We propose an entirely novel approach based on the conversion of the qualitative information on individuals' countries of origin into an aggregate firm-level diversity indicator based on UNEP's Human Development Index (HDI), a standard harmonized measure of cross-country variations that is available for virtually all countries in the world. We use this new aggregate measure to estimate state-of-the-art wage equations for Belgium that control for a range of observable and time-invariant unobservable factors, including variations in labour productivity between firms and within firms over time. Our results suggest that diversity is relatively unproblematic for wages in most Belgian firms – except for high diversity firms in which it turns out to be very problematic. The wage discrimination in high-diversity firms could be alleviated through stronger presence of collective bargaining and/or efforts to decluster foreigners from low-HDI countries in these firms.

Keywords: diversity, workers' origin, wages, discrimination, linked panel data

JEL Classification: J15, J16, J24, J31, J7

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Introduction

The recent surge in immigration from Africa and the Middle East into the European Union, especially into Germany and Sweden, has renewed controversies about the impact of a more diverse workforce on labour market outcomes such as working conditions and wages. In Germany, a country that experienced a net increase of more than 1.1 million foreigners in 2015 (Bundesamt für Migration und Flüchtlinge, 2016), this controversy led to renewed debates on the recently introduced federal minimum wage of 8.50 euros per hour (8.84 since 2017). In order to improve the employability of newly arrived immigrants with lower productive skills, the federal government proposed in early 2017 to exempt asylum seekers from minimum wage rules. This was heavily criticized by trade union representatives, who argued that asylum seekers, who might be less informed about worker rights and minimum standards, could be exploited as "cheap labour" by German employers.[1]

Whereas public debates on labour market impacts of a more diverse workforce tend to focus on the societal or macro level, a series of econometric studies has highlighted the importance of examining the wage effects of diversity at the firm or micro level. For the case of the U.S., for instance, Carrington and Troske (1998) have shown that ethnic diversity within manufacturing firms has a significant effect on wages, as the remuneration of black workers is decreasing and wages of white workers increasing if they have more black co-workers within the same establishment. For Swedish firms, Åslund and Skans (2010) show that ethnic groups with more immigrant co-workers earn less than those with more native colleagues. Their results also suggest that the more an individual is exposed to immigrants within his or her workplace, the lower will be the wage. A similar picture emerges from data on German firms in four metropolitan areas analyzed by Dustmann et al. (2015), who find that foreign workers with a greater share of immigrant co-workers suffer from a wage penalty.

A drawback of parts of the econometric literature on firm-level diversity is that the latter is often apprehended in terms of binary categories: "black" vs. "white", "natives" vs. "foreigners", "immigrants" vs "non immigrants", etc. (all empirical studies mentioned above use binary categories in their respective regressions). This is partly due to methodological constraints: most estimators require a limited number of explanatory variables to allow for statistical identification. In reality, though, diversity is a phenomenon with more facets than binary divisions. Rather than considering "immigrants" as a homogeneous group and oppose them to "natives", one would therefore like to obtain a more nuanced picture that distinguishes between, say, immigrants from neighbouring countries with relatively similar schooling and levels of economic development, from those that come from countries that radically differ from the host country. In the context of Belgium, for example, the impact of diversity is likely to differ drastically between a firm which employs immigrants from France or the Netherlands compared to a firm with immigrants from the Democratic Republic of the Congo or Syria – a nuance that binary approaches to firm-level diversity in terms of "natives" vs "foreigners" is not able to grasp.

This paper adopts an original and more nuanced approach to the question of firm-level diversity and applies it to linked employee-employer panel data for Belgium. In a nutshell, our approach consists of four steps. First, we use the United Nation's Human Development Index (HDI) of the employee's country of origin

[1] Süddeutsche Zeitung, January 2, 2017, Bundesregierung plant Ausnahmen für Flüchtlinge beim Mindestlohn. Retrieved on December 14, 2017 from http://www.sueddeutsche.de/wirtschaft/migranten-bundesregierung-plant-ausnahmen-fuer-fluechtlinge-beim-mindestlohn-1.3317242.

to convert qualitative variables related to diversity (country and nationality at birth) into a normalized quantitative variable. For example, a worker of Belgian origin is attributed the value 0.88 (the HDI of Belgium in 2010), a worker of Syrian origin the value of 0.64 (the HDI of Syria), and so forth. We have selected the HDI for converting the qualitative information relative to countries of origin into a quantitative scale because of the HDI's long-standing reputation as a standard measure of cross-country differences in socio-economic development, which is arguably a salient dimension of labour diversity. The HDI has also the advantage of being based on a harmonized and widely accepted methodology and produces a fine-grained picture of socio-economic differences between virtually all countries of the world. In a second step, we aggregate the individual-level HDI values of all workers within the same firm into a single measure of firm-level diversity. More specifically, our aggregate measure is based on average Euclidean distances that we calculated for all pair-wise combinations within the workforce of the firm, i.e. we compute the absolute difference between our Belgian and Syrian workers ($\sqrt{(0.88-0.64)^2}=0.24$) but also the differences between all other possible couples within the firm; we then take the average of all these pair-wise differences. In a third step, we use this aggregate measure of firm-level diversity to explain variations in firm-level wages. Our econometric approach is based on the regression framework proposed by Bartolucci (2014), who in turn builds on earlier work by Hellerstein et al. (1999), that has the advantage of addressing a variety of factors that potentially influence the link between diversity and wages, such as productivity, segregation and discrimination. In a final step, we adapt this regression framework to examine the moderating role of collective bargaining and diversity thresholds.

The paper is structured as follows. The next section reviews theoretical arguments for an influence of firm-level diversity in terms of countries of origin on wages. Section 2 presents our dataset and descriptive statistics. Section 3 briefly summarizes Bartolocci's regression framework and the estimators we use to identify the impact of diversity on wages. Section 4 presents and discusses our results and robustness tests. The final section concludes.

1 Diversity and firm-level wages

There is a vast literature on potential causal links between wages and firm-level diversity in terms of countries of origin. In this section we briefly summarize the theoretical arguments for such links by grouping them into three types of effects. We then discuss two moderating factors: collective bargaining and diversity thresholds.

1.1 Arguments for an influence of firm-level diversity on wages

Most theoretical explanations of correlations between diversity and wages can be grouped into three types of effects: productivity effects, sorting/segregation effects, and bargaining effects.

In the context of studies on diversity, productivity effects reflect the human-capital perspective on wage setting in which differences in wages between diverse workers are ultimately related to differences in productivity (see Garnero et al. (2014a) for an overview of the theoretical arguments). Such effects have been hypothesized and documented both at the individual and the collective level: intrinsic productivity differences between individuals from different countries of origin have been associated with language abilities (Dustmann and Van Soest, 2002; Hellerstein and Neumark, 2003), literacy skills (Ferrer et al., 2006), the quality and transferability of foreign education and training (Aeberhardt and Pouget, 2010; Gratsberg and Ragan, 2002) and less valuable labour market experience obtained abroad (Friedberg, 2000). Collective

productivity effects have been associated with positive or negative spillovers that arise when workers with different languages or customs work together in production processes (Böheim et al., 2012; Ottaviano and Peri, 2012).

A second set of causal explanations for wage differences between workers of different origin relates to non-random sorting and/or segregation effects. Most empirical studies have found evidence of non-random sorting related to ethnicity (Aeberhardt and Pouget, 2010; Åslund and Skans, 2010; Aydemir and Skuterud, 2008; Bayard et al., 1999; Carrington and Troske, 1998; Elliott and Lindley, 2008; Hellerstein and Neumark, 2008; Peri and Sparber, 2009). The most common categories into which non-random sorting occurs include job types, tasks, occupational nomenclatures, firms with different technologies or capital endowments and sectors of activity. As summarized by Kampelmann and Rycx (2016), whereas intrinsic productivity effects refer to differences between natives and immigrants within the same category (e.g. unequal productivity within the same occupation), segregation points to differences in the distribution of natives and immigrants across categories that each capture a certain level of productivity (e.g. overrepresentation of immigrants in occupations with lower productivity).

While much of the literature on diversity has focused on the two preceding types of causal explanations, the hypotheses we test in this paper focus on a third type of effect that has so far received less attention, namely bargaining effects. We argue that the latter can be interpreted as the correlation between diversity and the firm's wage level that remains after controlling for productivity and sorting effects: once the other causal factors are accounted for, additional variations in the "ceteris paribus wage" level arguably reflect the result of wage negotiation (bargaining) within the firm.

Some arguments related to bargaining suggest that diversity could lead to increases above the "ceteris paribus wage", whereas other mechanisms predict wage depression. Regarding the former, a wage increase would essentially mean that a more diverse workforce is in a better position to bargain a larger share of any rents that are generated by the firm. Such rent-extraction could be due to a stronger bargaining position of foreigners, such as high-skilled professionals, that have access to outside options in different countries. Employers could be forced to share rents with such workers in order to attract them to move. Moreover, some foreigners are likely to be less anchored in a specific cultural context and could therefore more credibly threaten to leave the company in search of a better paying offer in another country, which could strengthen their bargaining position and wage prospects. Another bargaining-related argument for a positive relationship between diversity and firm-level wages relates to the collective element of wage setting. A stronger presence of foreigners within a firm – which often goes hand in hand with higher diversity – could modify the bargaining power to the disadvantage of employers, making it for example more difficult for them to pay discriminatory wages. From a certain level of diversity, belonging to a minority could actually become the majority in a firm, thereby potentially reversing the conventionally assumed higher bargaining power of the "traditional" majority of native workers.

There are, however, also strong theoretical arguments in favor of a negative relationship between diversity and the firm's ceteris paribus wage level. This essentially boils down to an underpayment of a more diverse workforce with respect to productivity, which is the central element of the definition of discrimination by Heckman (1998). Classical explanations of discrimination have been proposed by Phelps (1972) and Arrow (1973) in the form of "statistical discrimination" and "preference-based discrimination". The first theory refers to the effect of negative stereotypes or a general lack of information of employers on the productivity of immigrants. The second theory refers to a situation in which the tastes of employers (or their employees or customers) translate into lower demand and lower wages for foreign workers. It is possible that higher levels of diversity, which can mean a larger number of different ethnicities, increase the likelihood of preference-based discrimination against a particular group of foreigners. It is typically assumed that a weaker

bargaining position increases the extent of wage discrimination. For instance, Bloomekatz (2007) suggests that some US employers selectively hire immigrants whose precarious legal status allows them to bargain extremely low wages. A less unified workforce in terms of language and cultural background could weaken its collective bargaining position vis-à-vis employers, for instance when such diversity makes it more difficult to establish trust, cohesion and common bargaining positions with the workforce. If, as proclaimed by the Belgian motto, "l'union fait la force" (unity makes strength), then diversity could weaken the bargaining strength of workers and their protection against wage discrimination. Another channel through which diversity could negatively affect wages is the effect of social networks, which, according to research by Seidel et al. (2000), tends to work against racial minorities in salary negotiations (minorities are shown to have on average less social ties to the organizations with whom they are negotiating wages).

The empirical approach based on Bartolocci's regression framework and matched employer-employee panel data from Belgium allows to account for both productivity and sorting effects; we will use this framework and the resulting ceteris paribus wage to provide evidence on the theoretical arguments above, i.e. whether the net effect of diversity on firm-level wages is positive or negative.

1.2 The moderating role of collective bargaining institutions

Certain institutional factors are likely to influence the relationships between diversity and the ceteris paribus wage. Most importantly, formal collective bargaining institutions could diminish wage discrimination against minority groups (Freeman, 1980; Plasman et al., 2007). In many countries, including Belgium, trade unions have presented themselves as advocates of "fair pay" for vulnerable groups (dell'Aringa and Lucifora, 1994; Pillinger, 2014). It should, however, be noted that the opposite view has been also discussed in the literature: trade unions could prioritize the exclusive interests of native workers, especially in situations and periods in which foreigners are not affiliated to trade union organizations, as was the case in the 1960 and 1970 in West Germany where trade unions openly defended the interests of German workers against wage demands of foreign Gastarbeiters (Kampelmann, 2011). Research on more recent periods shows that the question of whether unions are "inclusive" or "exclusive" with respect to workers with migration background has not been settled. For the case of New Zealand, for instance, Harcourt et al. (2008) argue that contrary to their rhetoric, trade unions have still been relatively unsuccessful in combating discrimination against immigrants and ethnic minorities.

Another aspect of institutionalized collective employment relations that could moderate the relationship between diversity and wages is the level of collective bargaining. For the question of firm-level wages, which is the focus of this paper, it seems worthwhile examining whether productivity-adjusted wage effects related to the presence of foreigners are smaller in companies with firm-level collective bargaining compared to those without firm-level agreements. In our dataset from Belgium, this hypothesis can be tested by splitting the sample into a) firms that are only covered by national- and sectoral-level bargaining and b) firms that have an additional round of bargaining at the establishment level. If collective bargaining prioritizes inclusiveness over the exclusive interests of native workers, we expect that wage discrimination is attenuated in firms with firm-level bargaining (dell' Aringa and Lucifora, 1994; Plasman et al., 2007).

1.3 No group dynamics without a group?

Independent from the question whether the hypothesized wage effects of diversity are positive or negative, it is important to bear in mind that most of the wage bargaining effects mentioned above only operate through mechanisms at the level of *groups*. This implies that it is unlikely to see any tangible consequences on wage setting outcomes if the presence of foreign or migrant workers is restricted to a few isolated individuals: only if migrants become a recognizable group in the firm, with certain characteristics that sets

them collectively apart from "native" employees, the hypothesized collective wage bargaining mechanisms we reviewed above can enter into play. In other words, an individual foreigner in a large company with an otherwise entirely native workforce is unlikely to affect the way in which salaries are negotiated within the company. However, if foreigners form a recognizable group within the company the bargaining process might change. For instance, their presence could reflect the employer's "preference" to pay discriminating wages to foreigners with weaker bargaining power (as hypothesized by Bloomekatz (2007)). In some cases, the discrimination against foreigners can also be incorporated into collectively negotiated pay scales, for instance when job categories in which foreigners are overrepresented are specifically designed to allow for wage discrimination (Kampelmann, 2011).

To investigate this issue, we will test whether the effect of diversity on ceteris paribus wages differs in firm with low, medium and high levels of diversity. Given that most of the mechanisms reviewed above rely on recognizable groups, we expect that the wage effects are stronger in firms with high levels of diversity, and small or inexistent in those with relatively few foreigners.

2 Data and descriptive statistics

2.1 Data set

Our empirical analysis is based on two large data sets spanning the period 1999-2010. The first is the Structure of Earnings Survey (SES) which covers all firms operating in Belgium that employ at least 10 workers and with economic activities within sections C to K of the NACE nomenclature (Rev. 1). The survey contains information provided by human resource departments on firm characteristics (e.g. sector of activity, number of workers, level of collective wage bargaining) and employees (e.g. age, education, gross earnings, paid hours, gender, occupation, etc).[2] The SES provides no financial information and has therefore been merged with a firm-level survey, the Structure of Business Survey (SBS). The SBS carries information on financial variables such as firm-level added value and gross operating surplus per hour. All variables in the SES-SBS are provided by the firm's management and therefore more precise compared to self-reported employee or household surveys. The SES also provides no information on workers' origin. This information (i.e. nationality at birth, country of birth and current nationality) has been taken from the National Register (NR) and merged by Statistics Belgium to the SES-SBS data.

The earnings measure in the SES corresponds to total gross wages, including premia for overtime, weekend or night work, performance bonuses, commissions, and other premia. Work hours represent total effective remunerated hours in the reference period (including paid overtime hours). The firm's added value per hour in the SBS is measured at factor costs and based on the total number of hours effectively worked by the firm's employees.

The coverage of the SBS differs from the SES in that it does not include the whole financial sector (NACE J) but only Other Financial Intermediation (NACE 652) and Activities Auxiliary to Financial Intermediation (NACE 67). The data collection and merger of the SES and SBS datasets has been carried out by Statistics Belgium using social security numbers. The capital stock of each firm has been calculated with the Permanent Inventory Method (PIM) using annual firm-level information on gross fixed capital formation.

[2] For a detailed description of the SES, see Demunter (2000).

Two filters have been applied to the original data set. Firstly, we deleted firms that are publicly controlled and/or operating in predominantly public sectors from our sample. The rationale of this filter derives from standard productivity theory and the requirement that prices have to be economically meaningful. All regressions are therefore applied to privately controlled firms only.[3] Secondly, in order to ascertain that firm averages are based on a sufficient number of observations we filtered out firms that provided information on less than 10 employees.[4]

Our final sample consists of an unbalanced panel of 9,430 firms and 555,963 individuals, yielding 30,355 firm-year-observations during the 12-year period (1999-2010). It is representative of all medium-sized and large firms employing at least 10 employees within sections C to K of the NACE Rev. 1 nomenclature, with the exception of large parts of the financial sector (NACE J) and almost the entire electricity, gas, and water supply industry (NACE E).

2.2 Diversity in terms of human development

In this paper we are concerned with workforce diversity in terms of the country of origin of individual workers. We propose an original approach to shed light on this issue by using the United Nation's Human Development Index (HDI) to convert the qualitative data on individual's origin into a normalized quantitative variable. We have selected the HDI for this purpose because of its long-standing reputation as a standard measure of cross-country differences in socio-economic development, which is arguably a salient dimension of labour diversity. The HDI has also the advantage of a harmonized and widely accepted methodology that produces a fine-grained picture of socio-economic differences between virtually all countries of the world. As stated by the United Nation's Human Development Report 2016, the HDI is the geometric mean of three normalized indices covering respectively "key dimensions of human development", namely "a long and healthy life" (measured through life expectancy at birth), "being knowledgeable" (measured through expected years of schooling and mean years of schooling) and "a decent standard of living" (measured through Gross National Income per capita in PPP) (UNDP, 2016).[5]

Using the UNDP's 2010 HDI values for the different national origins in our dataset, each worker is associated with the level of human development that corresponds to his or her specific origin, which we operationalized as the individual's nationality at birth (a variable taken from the National Register). For example, a worker of Belgian origin is attributed the value 0.88 (the HDI of Belgium), a worker of Syrian origin the value of 0.64 (the HDI of Syria), and so forth. Given that the HDI is updated on an annual basis since 1990, one could also associate the value of the HDI for a given country in a given year to each individual. For instance, an employee of Belgian origin could be attributed the value 0.87 if she is observed in 2000 (the HDI of Belgian in 2000) and 0.88 if observed in 2010. This, however, has the inconvenience of generating missing observations (the HDI covers virtually all countries of the world since 2010). Moreover, the focus of this paper lies on cross-country variations in human development rather than within-country variations over time, which is why we prefer to use the values of the HDI at a fixed point in time.

The average HDI in our sample equals 0.87, with a standard deviation of 0.03. A closer examination of different categories of workers reveals that the level of human development associated with the origin of individuals is not evenly distributed within the workforce. For instance, women have on average a slightly higher HDI than men (0.870 compared to 0.864), which arguably reflects the relatively larger proportion of

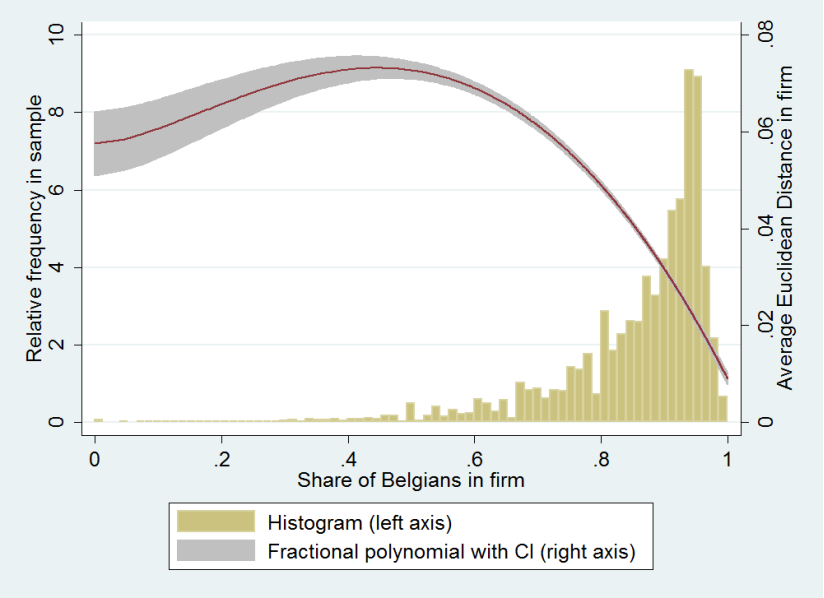
[3] More precisely, we eliminate firms for which public financial control exceeds 50%. This exclusion reduces the sample size by less than 2%.

[4] This selection is unlikely to affect our results as it leads only to a small drop in sample size.

[5] For a detailed description of the HDI's underlying calculations, see the Technical notes included in the UNDP's Human Development Report 2016: http://hdr.undp.org/sites/default/files/hdr2016_technical_notes_0.pdf (accessed on January 8, 2018).

male immigrants from low-income countries. Occupations are also differentiated with respect to the human development of the individuals in them: on average, managers have the highest HDI (0.88), followed by professionals (0.876), technicians (0.875), clerical occupations (0.874), machine operators (0.867), crafts (0.865), service occupations (0.863) and elementary occupations (0.844). We observe less differentiation between sectors of activity, except a particularly low average HDI in accommodation and food service activities (0.83). Differences between the three Belgian regions reflect the relatively larger presence of foreigners from low-HDI countries in the Brussels-Capital Region, whose average HDI is 0.85 compared to 0.871 in Flanders and 0.870 in Wallonia.

Figure 1. Firm-level average Euclidean distances and shares of Belgians



2.3 Firm-level diversity and descriptive statistics

In order to move from individual-level observations to an indicator of firm-level diversity, the HDI values within each firm's workforce need to be aggregated into a single measure of firm-level diversity. The aggregate measure used in this paper is based on Average Euclidean Distances (AED) that we calculated for all pair-wise combinations within the workforce of the firm. To continue the example above, we compute the absolute difference between a Belgian and Syrian worker ($\sqrt{(0.88-0.64)^2}=0.24$), but also the differences between all other possible couples within the firm; we then take the average of all these pair-wise differences.

Descriptive statistics for the 30,355 firm-year observations in our sample are shown in Table 1. The average AED in our sample of is 0.25, with a standard deviation of 0.035. Like for the case of individual HDI values, the AED is differentiated between regions, with firms based in Brussels being considerably more diverse than firms in Flanders and Wallonia (the regional averages of AED are 0.48, 0.21 and 0.24, respectively).

Table 1. Firm-level descriptive statistics, 1999-2010

	Full sample		Low diversity[e]		High diversity[f]		Very high diversity[g]	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Human Development Index (HDI)	0.87	0.03	0.88	0.01	0.83	0.04	0.78	0.04
Diversity indicators								
AED(HDI)[a]	0.03	0.04	0.01	0.01	0.08	0.03	0.13	0.02
SD(HDI)[b]	0.03	0.04	0.02	0.02	0.09	0.03	0.13	0.02
CV(HDI)[c]	0.04	0.05	0.02	0.02	0.11	0.04	0.17	0.03
Worker characteristics								
Women	0.27	0.24	0.27	0.24	0.27	0.24	0.27	0.24
Workers < 40 years	0.55	0.20	0.54	0.20	0.57	0.20	0.60	0.20
Education level 1 (ISCED 1-2)	0.32	0.33	0.30	0.32	0.38	0.34	0.47	0.34
Education level 2 (ISCED 3-4)	0.42	0.30	0.43	0.30	0.40	0.30	0.39	0.31
Education level 3 (ISCED 5-7)	0.25	0.27	0.26	0.27	0.22	0.26	0.14	0.19
Permanent labour contracts	0.97	0.10	0.97	0.09	0.95	0.13	0.93	0.16
High tenure (>5 years)	0.54	0.25	0.56	0.24	0.48	0.25	0.40	0.25
Occupations								
Managers	0.04	0.08	0.04	0.08	0.04	0.07	0.03	0.06
Professionals	0.10	0.19	0.10	0.19	0.09	0.18	0.04	0.12
Technical ass. professionals	0.08	0.15	0.08	0.16	0.07	0.14	0.04	0.12
Clerical occupations	0.19	0.22	0.20	0.22	0.17	0.21	0.14	0.20
Service occupations	0.07	0.20	0.06	0.19	0.09	0.23	0.15	0.30
Crafts	0.25	0.33	0.24	0.33	0.25	0.34	0.25	0.35
Machine operators	0.18	0.29	0.19	0.29	0.16	0.28	0.13	0.26
Elementary occupations	0.09	0.20	0.08	0.18	0.14	0.26	0.21	0.31
Firm characteristics								
Added value/hour[d]	55.90	435.85	58.29	494.01	48.74	166.30	43.28	230.14
Wage/hour[d]	15.60	5.65	15.85	5.92	14.87	4.67	13.10	3.17
Firm-level collective bargaining	0.19	0.40	0.20	0.40	0.17	0.38	0.14	0.35
Capital (ln)	10.68	1.61	10.75	1.58	10.50	1.65	10.22	1.75
Firm size (ln)	4.29	1.14	4.27	1.13	4.33	1.15	4.26	1.19
Mining and quarrying	0.01	0.08	0.01	0.08	0.00	0.06	0.00	0.00
Manufacturing	0.45	0.50	0.47	0.50	0.41	0.49	0.32	0.47
Electricity, gas and water	0.00	0.07	0.00	0.07	0.00	0.07	0.01	0.09
Construction	0.11	0.32	0.11	0.31	0.12	0.33	0.09	0.29
Wholesale and retail trade	0.19	0.39	0.20	0.40	0.14	0.35	0.13	0.33
Hotels and restaurants	0.02	0.15	0.01	0.10	0.07	0.25	0.18	0.39
Transport, storage, comm.	0.07	0.26	0.07	0.26	0.08	0.28	0.09	0.28
Financial intermediation	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.07
Real estate, renting and bus. services	0.13	0.33	0.12	0.32	0.15	0.36	0.17	0.38
Region								
Brussels	0.15	0.35	0.10	0.30	0.28	0.45	0.44	0.50

Wallonia	0.26	0.44	0.26	0.44	0.24	0.43	0.13	0.34
Flanders	0.60	0.49	0.64	0.48	0.48	0.50	0.43	0.49
Observations	30,355		22,767		7,588		1,517	

Notes: [a] AED: average Euclidean distances. [b] SD: standard deviation, [c] CV: coefficient of variation. [d] Constant euros. [e] We define relatively low diversity as a diversity indicator equal or below the 75th percentile of the AEDs distribution in the overall sample. [f] High diversity firms are defined as those with AEDs between the 75th and 95th percentile. [g] Very high diversity is defined by AED values that lie above the 95th percentile.

An interesting way to explore the firm-level distribution of AEDs in our sample is by looking at the relationship between AEDs and the proportion of native Belgians in each firm (Figure 1). The graph includes a histogram of the share of native Belgians (i.e. born in Belgium with Belgian nationality), whose relative frequencies are shown on the left-hand axis. As can be seen, only few firms have less than 80% of native Belgians.

The second information included in the figure is the relationship between the share of native Belgians, on the one hand, and the firm's AED, on the other hand. This relationship is captured by a fractional polynomial whose confidence interval is also depicted on the graph (the scale is given on the right-hand axis). The curve shows that firms with around 50% of foreigners are the most diverse. For values above 50%, the relationship between the AEDs and the proportion of Belgian workers is negative: as the proportion of foreigners approaches 0, the diversity goes also to 0. Conversely, when the proportion of Belgian workers approaches 0, the diversity is still high but a bit lower than at the maximum, presumably because these firms employ at least some foreigners from the same origin (and therefore similar HDIs). The left-hand tail of the distribution is, however, very rare in our sample. For the vast majority of observations, we observe a negative relationship between the AEDs and the proportion of Belgian workers.

3 Estimation strategy

3.1 Wage-setting equations at the firm level

Over several decades the contributions by Oaxaca (1973) and Blinder (1973) have provided the most commonly used tools for studying wage discrimination against immigrants. But the standard version of the Oaxaca-Blinder decomposition has attracted increasingly sharp criticism. First, by definition the residual gap confounds any unobserved intrinsic productivity differences or unobserved sorting with discrimination. Second, the method controls for differences in occupational or sectoral composition between natives and immigrants rather than explaining the process of sorting into groups with different productivity; it is therefore prone to a "potential selectivity bias" (Aeberhardt and Pouget, 2010). Third, the individual-level equations of the Oaxaca-Blinder framework ignore productivity spillover effects that occur at the level of the firm. The conclusion that Bartolucci (2014) draws from this is harsh: "As discrimination has normally been detected through the unexplained gap in wage equations and this approach is not the best option for disentangling differences in productivity and discrimination, there are few papers that address labor market discrimination against immigrants" (p.3).

The increasing availability of firm-level matched employer-employee data facilitated the emergence of an alternative approach to measuring discrimination. The new method has been developed by Hellerstein et al. (1999) and refined by Hellerstein and Neumark (2006), Vandenberghe (2011) and Van Ours and Stoeldraijer (2011) among others. It has now become standard in the literature regarding the productivity and wage effects of labor heterogeneity (Cardoso et al., 2011, Devicienti et al., 2018; Garnero et al., 2014a,b; Giuliano et al., 2017; Göbel and Zwick, 2012; Vandenberghe, 2013). It is based on the separate estimation of an

added-value function and a wage equation at the firm level: the added-value function yields estimates for the average marginal product of each category of workers (natives, immigrants, etc.), while the wage equation estimates the respective impact of each group on the average wage paid by the firm. Estimating both equations with the same set of explanatory variables allows comparing the parameters regarding the (average) marginal product and the (average) wage.

The method developed by Hellerstein et al. (1999) captures compositional and sorting effects that are ignored by the Oaxaca-Blinder framework; crucially, the productivity differences associated with observable characteristics are directly measured instead of being assumed. However, these advantages often deliver potential rather than actual mileage: while the firm-level wage setting equations in the Hellerstein et al. (1999) framework are generally robust to different specifications and provide precise estimates, the identification of the production function is often far more problematic due to high standard errors and noise in the productivity measures (Göbel and Zwick, 2012; Vandenberghe, 2013). Bartolucci (2014) argues that it is difficult to obtain precise estimates of the relative productivity parameter. Indeed, the search for the appropriate form of the production function is a long-standing quest in the micro-econometric literature (Ackerberg et al., 2015). While empirical studies focusing only on the firm-level productivity function are more flexible in the choice of both the functional form and the statistical estimator, the Hellerstein et al. (1999) method imposes a symmetry between both wage-setting and productivity equations in order to ensure the comparability of the respective parameters, which is why most studies use the simple CES or Cobb-Douglas form and FE or GMM-IV estimators for both equations. The underlying problem is that the compelling theoretical reasons to use Olley-Pakes (Olley and Pakes, 1996) or Levinson-Petrin (Petrin et al., 2004) estimators for the production functions often lack a theoretical rationale in the case of wage equations. The fact that some firm-level studies on immigration estimate only productivity functions (Nicodemo, 2013; Paserman, 2013) and others only wage equations (Böheim et al., 2012) is a way to circumvent this issue but comes at the price of renouncing from measuring wage discrimination.

In this paper, we build on a method developed by Bartolucci (2014) that a) avoids the specification of the functional form of the productivity equation but nevertheless directly uses firm-level productivity data to measure discrimination against immigrants; b) neither assumes perfect competition in the labor market nor a linear relationship between wages and productivity (it allows for non-unitary wage-productivity elasticities); and c) produces a measure of wage discrimination against immigrants that is robust to labor market segregation.[6]

The wage-setting equation proposed by Bartolucci is similar to the wage equation in the Hellerstein et al. (1999) framework but directly estimates a parameter for the logarithm of average firm-level productivity. The integration of measured productivity yields the following wage equation:

$$\log(\overline{w}_{j,t}) = \alpha_j + \beta \log(\overline{p}_{j,t}) + \gamma\, AED_{j,t} + \lambda\, X_{j,t} + \varepsilon_{j,t} \qquad (1)$$

where the dependent variable $\log(\overline{w}_{j,t})$ is the logarithm of the average hourly wage in firm j in year t; the variable $\log(\overline{p}_{j,t})$ the logarithm of average hourly productivity; AEDj,t is the Average Euclidean Distance and γ the parameter that captures potential wage discrimination; $Xj_{,t}$ is a vector containing a set of observable characteristics of firm j and its labour force in year t, including controls for the occupational, educational and sectoral composition of the firm (the full set of control variables is shown on Table 1).

[6] For space reasons we do not reproduce the demonstration of these properties provided by Bartolucci (2014).

3.2 Estimation methods

Equation 1 can be estimated using different methods. Basic pooled OLS estimators of productivity models have been criticized for their potential "heterogeneity bias" (Vandenberghe, 2013) due to the fact that firm productivity and mean wages depend to a large extent on firm-specific, time-invariant characteristics that are not measured in micro-level surveys. As a consequence, these estimators might be biased since unobserved firm characteristics may simultaneously affect the firm's added value (or wage) and the composition of its workforce.

Empirical studies have shown that firm-level fixed-effects are important for the wage differentials between male immigrants and male natives and attenuate the problem of unobserved firm characteristics (Aydemir & Skuterud, 2008), but the fixed-effect estimator does not address the potential endogeneity of the explanatory variables. For several reasons the composition of a firm's workforce is potentially endogenous: firstly, the average wage offered by the firm might influence its attractiveness for workers, and a relatively higher wage could attract workers with better unobserved skills; secondly, shocks in productivity levels or wages might generate correlated changes in the firm's composition: for instance, in periods of cyclical downturn firms might lay off more immigrants than natives. In order to tackle both firm-fixed unobserved heterogeneity and potential endogeneity, we estimate all three equations using a GMM-IV specification in first differences with instrumental variables (Black and Lynch, 2001; Dearden et al., 2006). We use two types of instruments. Following Van Ours and Stoeldraijer (2011) and Göbel and Zwick (2012), the first type of variable instruments the first-differenced AEDs with their lagged levels. The implicit assumption is that changes in wages in one period, although possibly correlated with contemporaneous variations in the AEDs, are unrelated with lagged levels of the latter. Moreover, changes in the AEDs are assumed to be sufficiently correlated to their past levels. The second instrument is the annual average AED in the sector in which firm j operates.7 The rationale for this instrument is that sector AEDs can be shown to be correlated with the AED of firm j while being unrelated to the productivity of firm j and the error term (Garnero, 2015).

In order to assess the soundness of this approach we performed a range of statistical tests. The first test measures whether the correlation between the instrumental variables and the endogenous variables is sufficiently strong, i.e. that the instruments are not 'weak'. For this purpose we used the Kleibergen-Paap rk Wald F statistic. Under the null hypothesis the instruments are weak. A standard rule of thumb is to reject the null hypothesis if the F-statistic is at least 10 (Van Ours and Stoeldraijer, 2011). The second test is the Kleibergen-Paap rk LM statistic, whose null hypothesis is that the equation is underidentified. The third test concerns the validity of the instruments and uses the Hansen (1982) test of overidentifying restrictions. Under the null hypothesis the instruments are valid, i.e. uncorrelated with the error term. A fourth indicator tests whether the AEDs are indeed endogenous so that an IV approach is warranted. Under the null hypothesis the explanatory variables can actually be treated as exogenous.

4 Results

In this section we confront the different theoretical arguments presented in Section 2 with empirical evidence based on estimations of Equation 1. We present results for three variations: the benchmark results for the entire sample (Section 5.1); separate estimations for firms with and without firm-level collective

[7] The average is calculated excluding the firm *j*.

bargaining (Section 5.2); and separate estimations for firms with low, high and very high levels of diversity (Section 5.3).

4.1 Benchmark results

Table 2 presents the results for the three different estimators discussed in Section 4.2: OLS, firm fixed-effects, and GMM-IV. To examine the effect of the control variables in the model, we also show OLS estimates without individual and firm controls (column 1); with individual but no firm controls (column 2); and including both individual and firm controls (column 2). The effect of the control variables on the magnitude of the diversity coefficient is considerable: the size of coefficient associated to the AED drops from -1.14 (without any controls) to -0.08 (including all controls). This result suggests that higher diversity is strongly correlated with variables that are relevant for firm-level wage setting. The large difference between the AED coefficients in the first two columns of Table 2 indicates that individual control variables (gender, age, education, tenure, contract type) are responsible for the bulk of this effect.

Table 2. Estimations of firm-level wage-setting equations, 1999-2010

Dependent variable: average hourly wage (log)	OLS	OLS	OLS	Fixed-effects	GMM-IV
	(1)	(2)	(3)	(4)	(5)
AED(HDI)[a]	-1.14***	-0.10**	-0.08**	-0.15***	-0.37**
	(0.06)	(0.04)	(0.04)	(0.04)	(0.18)
Share of women[b]		-0.20***	-0.17***	-0.10***	-0.13***
		(0.01)	(0.01)	(0.02)	(0.04)
Workers < 40 years		-0.16***	-0.18***	-0.14***	-0.12***
		(0.01)	(0.01)	(0.01)	(0.01)
Education level 2 (ISCED 3-4)		0.36***	0.27***	0.12***	0.11***
		(0.01)	(0.01)	(0.01)	(0.01)
Education level 3 (ISCED 5-7)		0.06***	0.04***	0.02***	0.01***
		(0.00)	(0.00)	(0.00)	(0.00)
Managers		0.92***	0.79***	0.51***	0.54***
		(0.03)	(0.03)	(0.02)	(0.03)
Professionals		0.42***	0.34***	0.21***	0.23***
		(0.02)	(0.01)	(0.01)	(0.02)
Technical ass. professionals		0.26***	0.17***	0.08***	0.09***
		(0.01)	(0.01)	(0.01)	(0.02)
Clerical occupations		0.04***	-0.03***	-0.06***	-0.07***
		(0.01)	(0.01)	(0.02)	(0.02)
Crafts		0.07***	-0.03***	-0.06***	-0.07***
		(0.01)	(0.01)	(0.01)	(0.02)
Machine operators		0.20***	0.15***	0.08***	0.08***
		(0.01)	(0.01)	(0.01)	(0.02)
Elementary occupations		0.01	-0.05***	-0.06***	-0.07***
		(0.01)	(0.01)	(0.01)	(0.02)
High tenure (>5 years)		0.17***	0.10***	0.05***	0.05***
		(0.01)	(0.01)	(0.01)	(0.01)

Permanent labour contracts		0.04***	0.06***	0.06***	0.06**
		(0.01)	(0.01)	(0.01)	(0.03)
Hourly added value (ln)			0.10***	0.01***	0.00
			(0.00)	(0.00)	(0.00)
Capital (ln)			0.00	0.00	0.00
			(0.00)	(0.00)	(0.00)
Firm size (ln)			0.03***	0.00	-0.00**
			(0.00)	(0.00)	(0.00)
Firm-level collective bargaining			0.03***	0.00	0.00
			(0.00)	(0.00)	(0.00)
Brussels			0.01*		0.01
			(0.00)		(0.01)
Wallonia			-0.03***		-0.01
			(0.00)		(0.01)
Constant	2.70***	2.45***	2.07***	2.64***	0.07***
	(0.01	(0.02)	(0.02	(0.02)	(0.00)
Sector dummies	no	no	yes	no	yes
Year dummies	yes	yes	yes	yes	yes
Observations	30355	30355	30355	30355	12421
R^2	0.07	0.63	0.7	0.35	0.3
R^2 within				0.35	
R^2 between				0.64	
Underidentification test[c]					0.00
Weak identification test[d]					56.88
Overidentification test[e]					0.11
Endogeneity test[f]					0.31

Notes: HAC standard errors in parentheses. ***,**,* significant at 1, 5 and 10% levels, respectively. [a] AED(HDI): firm-level average Euclidean distance of human development index.

[b] Reference categories are share of men; education level 1 (ISCED 1-2); service occupations; share of fixed-term contracts; share of workers with more than 5 years of tenure; Flanders; manufacturing sector. [c] Underidentifcation test reports p-value of Kleibergen-Paap rk LM statistic. [d] Weak identification test reports Kleibergen-Paap rk Wald F statistic. [e] Overidentification test reports p-value of Hansen J statistic. [f] Endogeneity test shows probability that endogenous regressors can actually be treated as exogenous.

OLS estimators are biased if unobservable variables play an important role in the wage-setting process. The fixed-effect estimator (column 4) accounts for unobservable firm-level time-invariant variables. The resulting AED coefficient is higher compared to the OLS equations (columns 2 and 3). Contrary to the ***observable*** individual and firm characteristics, the ***unobservable*** time-invariant characteristics of the firm and its workforce increase the size of the negative effect of diversity on wages; in other words, diversity appears to be stronger in firms with unobservable characteristics that have a positive effect on the average wages.

The AED coefficient derived from a GMM-IV estimator equals -0.37 and is therefore higher compared to both the OLS and FE coefficients. The different post-estimation tests reported at the bottom of the table (column 5) suggest that the variables of interest are not endogenous. We have confidence in the validity of this endogeneity test since the instruments we use in the GMM-IV are sound: the tests for weak, over- and underidentification suggest that the instrumentation is satisfactory. Given that AED therefore appears not to be endogenous, the FE is more efficient compared to the GMM-IV and therefore our preferred estimator.

How should the FE diversity coefficient of -0.15 be interpreted? Following Bartolucci's interpretation of Equation 1, the coefficient captures a ceteris paribus effect of diversity on the firm's average wage that controls for the workforce composition, firm characteristics and, crucially, firm-level productivity. The latter is statistically significant in the OLS and FE models (columns 3 and 4, respectively). This means that the negative coefficients we observe in Table 2 are evidence for wage discrimination: the negative association between firm-level diversity and wages is not justified by productivity differences or other wage-related factors. Higher diversity is correlated with lower ceteris paribus wages and therefore higher discrimination.

How big is the magnitude of the observed wage discrimination? Should a coefficient of -0.15 be regarded as strong discrimination against a more diverse workforce? To answer these questions, it is useful to go back to the descriptive statistics presented in Table 1. In our sample, the average HDI equals 0.87 (with a standard deviation of 0.03) and the average AED equals 0.03 (with a standard deviation of 0.04). Based on the average across all firms, this means that the average Euclidean distance between two workers is 0.03. This is a relatively low gap in HDI values. Compared to the HDI of a Belgian worker (0.88), only 24 out of 195 countries classified by UNDP (2016) yield a distance in terms of human development equal or below 0.03. Most of these countries are Belgium's Western European neighbours or OECD countries.

We can illustrate the magnitude of potential changes in firms' AED through hypothetical examples. If a Belgian firm was composed of one individual from each country for which UNDP has calculated HDIs, the diversity would be much higher than the current value of 0.03: in such a hypothetical multicultural firm the AED would equal 0.21. A more realistic example would be a firm composed of 30 workers of Belgian origin (and hence an AED = 0) that recruits 10 individuals with Moroccan background (which is one of the most frequent foreign nationality in Belgium: around 20% of foreigners in our sample were born in Morocco). In this case the AED of the firm would increase to 0.068. The wages decrease due to discrimination – that is the decrease *beyond* variables related to productivity, sorting and segmentation – would equal 0.063 x -0.15 = -0.01, or -1 percentage point. These examples suggest that only relatively abrupt changes in the diversity of a firm's workforce lead to sizable wage discrimination effects. This being said, this numeric exercise also illustrates that such abrupt changes are not improbable in countries with increasingly diverse workforces. In Germany, for instance, the workforce increased by 1.5 % in the single year of 2017, mostly due to foreigners finding work in the German economy. Moreover, we will show below that in certain firms the discriminatory effects are more than 3 times higher than the benchmark estimations; this means that more subtle changes in diversity can already lead to sizable changes in firm-level wages.

4.2 The role of collective bargaining

A testable hypothesis that we formulated in Section 2.2 postulates that collective bargaining institutions could reduce the link between firm-level diversity and wage discrimination. We now present estimation results on the moderating role of a specific type of collective bargaining in the Belgian labour market, namely the renegotiation of national and/or sectoral wage agreements through firm-level bargaining. We obtain these estimates by dividing the full sample of into firms that have renegotiated collective agreements (this concerns our 20 % of observations) and those that apply only national and/or sectoral agreements (the remaining 80%). Under the hypothesis that trade unions work towards wage equality and the reduction of any discriminatory pay that was not eliminated in national or sectoral agreements that are binding for all companies, the renegotiation at the local level would reduce the extent of wage discrimination picked up by the diversity coefficient in Equation 1. The results presented in Table 3 provide evidence that this is indeed the case: the negative impact of the AED on the average hourly wage equals -0.13 in firms that renegotiate wages (column 7); this effect is significantly lower than the one estimated for full sample (column 6) and the sample of firms without firm-level renegotiation (column 8). The estimated effect is relatively modest: the

difference between the two sub-samples equals 0.04, suggesting that a change in the order of one standard deviation of the AED is associated with an increase in wage discrimination of one percentage point.

Table 3. Separate estimation of wage-setting equations in samples with and without firm-level collective bargaining, 1999-2010

Dependent variable: average hourly wage (log)	**Full sample**	**Firm-level collective bargaining**	**No firm-level collective bargaining**
	Fixed-effects	**Fixed-effects**	**Fixed-effects**
	(6)	**(7)**	**(8)**
AED(HDI)[a]	-0.15***	-0.13*	-0.17***
	(0.04)	(0.08	(0.04)
Share of women[b]	-0.10***	-0.13***	-0.10***
	(0.02)	(0.03)	(0.03)
Workers < 40 years	-0.14***	-0.13***	-0.14***
	(0.01)	(0.02)	(0.01)
Education level 2 (ISCED 3-4)	0.12***	0.17***	0.10***
	(0.01)	(0.02)	(0.01)
Education level 3 (ISCED 5-7)	0.02***	0.01	0.01***
	(0)	(0.01)	(0)
Managers	0.51***	0.47***	0.54***
	(0.02)	(0.06)	(0.03)
Professionals	0.21***	0.24***	0.21***
	(0.01)	(0.03)	(0.02)
Technical ass. professionals	0.08***	0.08***	0.09***
	(0.01)	(0.03)	(0.02)
Clerical occupations	-0.06***	-0.06**	-0.06***
	(0.02)	(0.03)	(0.02)
Crafts	-0.06***	-0.06**	-0.06***
	(0.01)	(0.03)	(0.02)
Machine operators	0.08***	0.11***	0.08***
	(0.01)	(0.03)	(0.01)
Elementary occupations	-0.06***	-0.08***	-0.06***
	(0.01)	(0.03)	(0.02)
High tenure (>5 years)	0.05***	0.05***	0.05***
	(0.01)	(0.01)	(0.01)
Permanent labour contracts	0.06***	0.02	0.07***
	(0.01)	(0.03)	(0.01)
Hourly added value (ln)	0.01***	0.01	0.01***
	(0.00)	(0.01)	(0.00)
Capital (ln)	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Firm size (ln)	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Constant	2.64***	2.78***	2.60***

	(0.02)	(0.06	(0.03)
Sector dummies	no	no	no
Year dummies	yes	yes	yes
Observations	30,355	5,899	24,456
R^2	0.35	0.4	0.34
R^2 within	0.35	0.4	0.34
R^2 between	0.64	0.65	0.64

Notes: HAC standard errors in parentheses. ***,**,* significant at 1, 5 and 10% levels, respectively.

[a] AED(HDI): firm-level average Euclidean distance of human development index. [b] Reference categories are share of men; education level 1 (ISCED 1-2); service occupations; share of fixed-term contracts; share of workers with more than 5 years of tenure; Flanders; manufacturing sector.

4.3 The impact of the level of diversity

A second testable hypothesis relates to the importance of group dynamics for wage discrimination to become effective with firms. According to the reasoning presented in Section 2.3, it seems likely that such group dynamics will unfold only if a certain critical mass of diversity is reached. In order to test for the presence of such thresholds, we have estimated separate wage equations for three sub-samples that differentiate between firms with low, high and very high diversity.

The definition of the three subsamples is based on the percentile distribution of AEDs in the overall sample. We define relatively low diversity as a diversity indicator equal or below the 75th percentile (AED = 0.037). High diversity firms are defined as those with AEDs between the 75th and 95th percentile (AED = 0.11). Very high diversity is defined by AED values that lie above the 95th percentile. The three subsamples therefore include respectively 75, 20 and 5 % of the firm-year observations that make up the full sample.

The estimation results of the preferred FE estimator are presented in Table 4. They provide evidence that wage discrimination related to firm-level diversity can only be detected in firms with high or very high diversity. In the majority of firms that lie below the 75th percentile, the diversity coefficient is also negative but not statistically different from zero. Another remarkable result is that the size of the effect increases with the extent of diversity: compared to the full sample (column 9), the effect of the same change in diversity on wages is 4 percentage points greater in firms with high diversity (column 11) and 35 percentage points greater in firms with very high diversity (column 12). This finding suggests that most firms are not concerned by a link between diversity and wage discrimination; in the average firm, diversity is arguably not visible or influential enough to affect wage-setting processes beyond those that are associated with other variables included in the model. But in firms with high levels of diversity a strong mechanism towards wage depression seems to be at work. A relative modest change in the composition of high diversity firms leads to sizable changes in average wages: in the numerical example of a firm with 30 Belgian workers recruiting 10 additional workers with Moroccan HDIs, the decrease in wages equals 3.4 percentage points. In sum, the evidence presented in this section suggests that diversity is unproblematic for wages in most firms – except for high diversity firms in which it is very problematic indeed.

Table 4. Separate estimation of wage-setting equation in samples with low, high, and very high diversity, 1999-2010

Dependent variable: average hourly wage (log)	**Full sample**	**Low[c]**	**High[d]**	**Very high[e]**
	Fixed-effects	**Fixed-effects**	**Fixed-effects**	**Fixed-effects**
	(9)	**(10)**	**(11)**	**(12)**

AED(HDI)[a]	-0.15***	-0.02	-0.19***	-0.50**
	(0.04)	(0.11)	(0.06)	(0.20)
Share of women[b]	-0.10***	-0.11***	-0.08***	-0.09**
	(0.02)	(0.03)	(0.02)	(0.04)
Workers < 40 years	0.02***	-0.14***	-0.10***	-0.10***
	(0.00)	(0.01)	(0.02)	(0.04)
Education level 2 (ISCED 3-4)	-0.14***	0.12***	0.09***	0.07
	(0.01)	(0.01)	(0.02)	(0.04)
Education level 3 (ISCED 5-7)	0.12***	0.02***	0.01	0.01
	(0.01)	(0.00)	(0.01)	(0.02)
Managers	0.08***	0.47***	0.63***	0.27*
	(0.01)	(0.03)	(0.06)	(0.14)
Professionals	-0.06***	0.19***	0.27***	0.36***
	(0.02)	(0.02)	(0.04)	(0.08)
Technical ass. professionals	-0.06***	0.07***	0.11***	0.14***
	(0.01)	(0.02)	(0.03)	(0.05)
Clerical occupations	0.08***	-0.06***	-0.02	0.01
	(0.01)	(0.02)	(0.02)	(0.03)
Crafts	-0.06***	-0.07***	-0.01	0.00
	(0.01)	(0.02)	(0.02)	(0.04)
Machine operators	0.05***	0.08***	0.10***	0.12**
	(0.01)	(0.02)	(0.03)	(0.05)
Elementary occupations	0.06***	-0.07***	-0.02	-0.01
	(0.01)	(0.02)	(0.02)	(0.04)
High tenure (>5 years)	0.51***	0.05***	0.05***	0.06**
	(0.02)	(0.01)	(0.01)	(0.03)
Permanent labour contracts	0.21***	0.06***	0.04	0.01
	(0.01)	(0.01)	(0.03)	(0.05)
Hourly added value (ln)	0.01***	0.01**	0.01	-0.01
	(0.00)	(0.00)	(0.01)	(0.02)
Capital (ln)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Firm size (ln)	0.00	-0.00*	0.00	0.02***
	(0.00)	(0.00)	(0.00)	(0.01)
	0.00	0.00	0.00	0.01
Firm-level collective bargaining	(0.00)	(0.00)	(0.01)	(0.01)
Constant	2.64***	2.67***	2.58***	2.54***
	(0.02)	(0.03)	(0.05)	(0.10)
Sector dummies	no	no	no	no
Year dummies	yes	yes	yes	yes
Observations	30,355	22,767	7,588	1,517
R^2	0.35	0.33	0.39	0.42
R^2 within	0.35	0.33	0.40	0.43
R^2 between	0.64	0.63	0.66	0.54

Notes: HAC standard errors in parentheses. ***,**,* significant at 1, 5 and 10% levels, respectively.

[a] AED(HDI): firm-level average Euclidean distance of human development index. [b] Reference categories are share of men; education level 1 (ISCED 1-2); service occupations; share of fixed-term contracts; share of workers with more than 5 years of tenure; Flanders; manufacturing sector. [c] We define relatively low diversity as a diversity indicator equal or below the 75th percentile of the AEDs distribution in the overall sample. [d] High diversity firms are defined as those with AEDs between the 75th and 95th percentile. [e] Very high diversity is defined by AED values that lie above the 95th percentile.

4.4 Robustness test

Given the novelty of our approach to convert qualitative data on workers' origin into a quantitative indicator of diversity, we carried out a number of robustness tests to assess the sensitivity of our results to methodological choices. None of these tests alters the main observations borne out by the discussion of results in the previous three sections.

A first type of robustness test was concerned with the choice of the reference year for the HDI values that are applied to each nationality in our sample. For reasons presented in Section 3.2, the benchmark regressions presented above use HDI from 2010 (i.e. the last year for which our sample includes observations). We re-estimated the regressions using the reference years 2000 and 1990, which are the two previous years for which UNDP has published HDI values for a large sample of countries. Probably due to the strong inertia in human development values, the estimation coefficients are not much affected by the choice of the reference year (detailed regression outputs of the robustness tests are available upon request).

Another robustness test concerns the impact of methodological choices related to the aggregation of individual HDI values into a firm-level indicator of diversity. As summarized by Kampelmann (2016), methodological choices underlying such aggregation can impact the numerical values of summary indicators. In addition to the use of average Euclidean distances on which we have based the regression results above, we have re-estimated all regressions using two alternative summary indicators of diversity that respectively use the standard deviation and coefficient of variation of HDIs within each firm as main explanatory variable. Again, the estimated coefficients are close enough to the benchmark estimations to conclude that our benchmark results are robust to methodological choices.

5 Conclusion

In most OECD countries it is increasingly common that most firms employ diverse workforces including employees from different countries of origin. The impact of this diversity has been the object of intense study in labour economics, albeit with an uncomfortable methodological limitation: most attempts at the measuring the impact of diversity – and indeed at measuring diversity itself – have involved metrics that eliminate most of the economically relevant distances between different countries of origin. The typical example of such as metric involves diversity indicators that divide the firm's workforce into black and white, foreign and native, European and non-European, etc.

The approach used in this paper is entirely novel and based on the conversion of the qualitative information on individuals' countries of origin into an aggregate firm-level diversity indicator based on UNDP's Human Development Index, a standard harmonized measure of cross-country variations that is available for virtually all countries in the world. We have used this new aggregate measure of firm-level diversity in state-of-the-art wage equations that control for a range of observable and time-invariant unobservable factors, including differences in labour productivity between firms and within firms over time.

The estimated parameters for the Belgian labour market can be interpreted as evidence for a significant impact of firm-level diversity on average wages. Since these effects occur above and beyond other ceteris paribus factors related to productivity as well as individual and firm characteristics, they can be interpreted as wage discrimination. Compared to the levels of aggregate diversity at the firm-level that are observed in Belgium, the absolute magnitude of this wage discrimination is relatively modest: an abrupt shift in the firm's workforce composition is required to yield upward or downward changes in the wage level of more than one percentage point. The extent of wage discrimination is further lowered if we account for the moderating role that collective bargaining could play. For the case of Belgium, where national and sectoral collective agreements apply to virtually all firms but in which local collective renegotiation happens only in some firms, we are able to provide evidence that collective bargaining at the firm-level attenuates the link between diversity and wage discrimination.

Should one conclude from these results that diversity-related wage discrimination is a minor nuisance for which, even if it occurs, an effective remedy exists in the form of institutionalized collective bargaining? Additional evidence based on diversity thresholds suggests that diversity is indeed relatively unproblematic for wages in most Belgian firms – except for high diversity firms in which it turns out to be very problematic. We interpret this finding that it is not diversity per se that sparks a mechanism of discriminatory wage setting, but levels of diversity that lie far above the composition of the average firm. This observation can be accounted for by the hypothesis that group dynamics linked to diversity appear only in high-diversity firms that are characterized by a sizable and recognizable share of individuals with sub-standard human development indices. In terms of policy recommendations, our results suggest to worry less about diversity in general and instead focus on specific spots in the economy that concentrate particularly high levels of diversity. The discrimination in these locations could be alleviated through stronger presence of collective bargaining or interventions aimed at avoiding or reducing the clustering of foreigners from low-HDI countries in such settings.

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