IZA DP No. 10159

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August 2016

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ABSTRACT

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This paper is one of the first to use employer-employee data on wages and labor productivity to measure discrimination against immigrants. We build on an identification strategy proposed by Bartolucci (2014) and address firm fixed effects and endogeneity issues through a diff GMM-IV estimator. Our models also test for gender-based discrimination. Empirical results for Belgium suggest significant wage discrimination against women and (to a lesser extent) against immigrants. We find no evidence for double discrimination against female immigrants. Institutional factors such as firm-level collective bargaining and smaller firm sizes are found to attenuate wage discrimination against foreigners, but not against women.

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

Keywords: wages, productivity, discrimination, workers' origin, gender, linked employer-employee panel data

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1. Introduction

Immigration flows into OECD countries are marked by both sharp fluctuations and considerable diversity between countries. Taken all countries together, however, net immigration has been consistently positive since the 1960s. The first decade of the new century witnessed a new surge of inflows: between early 2000 and late 2010, the stock of foreign-born residents in the OECD rose by around 35% from 75 million to 100 million (OECD 2014: 1). In 2011, foreign-born individuals represented less than 10% in most Eastern European countries, Greece and Portugal; between 10% and 20% in the rest of the European Union and the US (14.9% in Belgium); and more than 20% in Australia, Canada, Luxembourg and Switzerland (OECD 2014).

In this paper we are concerned with the relationship between the employment of immigrants and wages, a field of intense empirical and theoretical research in labor economics since the 1950s (Becker 1957, Chiswick 1978, Arrow 1998, Altonji et Blank 1999, Arai and Thoursie 2009, Baert and Cockx 2013; Baert and De Pauw, 2014, Baert et al. 2014, 2015). The empirical research in this area is marked by the observation that on average foreign workers with comparable productivity-related characteristics than natives receive lower wages (Bevelander and Veenman 2008, Chiswick et al. 2008, Meurs and Pailhe 2010, Barrett et al. 2012, McGuinness and Byrne 2014, Arai et al. 2015). The relevance of this relationship partly stems from its connection to a series of distributional issues, and especially concerns about discrimination and retributive justice. It is also related to other policy debates on immigration, for instance whether countries with wage penalties fail to attract skilled foreign labor or whether the labor supply increase due to immigration exerts downward pressure on native wages.

Wages of immigrants have been studied at different levels: individual Mincer-types regressions, but also cities, regions and countries have been the most popular levels of analysis (Borjas and Katz 2007; Arai and Nekby 2007, Arai and Thoursie 2009, Meurs and Pailhe 2010, Dustmann et al. 2013; Mitaritonna et al. 2014, Simon et al 2014, Arai et al. 2015). While studying wage discrimination at these levels is often justified on empirical and theoretical grounds (Ottaviano and Peri 2012), they are unable to capture appropriately the most important explanans in economic wage theory: labor productivity. Arguing that the latter depends to a large extent on the immediate context in which the employee operates – how much capital is at her disposition? how qualified are her co-workers? what type of technology does the firm use? etc – a small strand of the literature started to explore wage discrimination against immigrants with firm-level data (Hellerstein et al. 1999; Aydemir and Skuterud 2008).

Our paper adds to the literature that consists of the few existing studies that measure wage discrimination against immigrants while accounting directly for productivity effects at the firm level. First, we apply a very recent approach to estimating firm-level wage discrimination against immigrants developed by Bartolucci (2014); we are the first to estimate these effects with a large matched employer-employee dataset covering the Belgian labor market, a country that is generally considered as having comparatively strong anti-discrimination legislation. Second, we address various econometric issues neglected in previous studies such as the potential endogeneity of foreign workers and unobserved time-invariant firm characteristics (we present both FE and GMM-IV estimators). Third, we improve on firm-level studies that focus only on male migrants (Aeberhardt and Pouget 2010) and study the respective wage effects of the employment of male natives, female natives, male immigrants and female immigrants. Fourth, we test additional hypotheses on whether

wage discrimination against foreigners is affected by the level of collective bargaining and firm size.

The paper is structured as follows. Section 2 summarizes the literature on wage discrimination against immigrants and discusses three potential sources of productivity differences between natives and immigrants. Section 3 presents our methodological approach for measuring the relationship between foreign employment, on the one hand, and average wages at the firm level on the other hand. Section 4 presents our dataset and descriptive statistics, whereas Section 5 includes the results of our regression analysis that are discussed in the concluding Section 6.

2. Literature review

2.1. Wage discrimination

The conventional definition of wage discrimination in labor economics is inseparably linked to the notion of productivity. According to the definition of Heckman (1998), wage discrimination corresponds to a situation in which an employer pays a different wage to two otherwise identical individuals but who differ with respect to a characteristic such as gender or race – with the crucial qualification that these characteristics have no direct effect on productivity.

A mismatch between wage gaps and productivity gaps may arise for different reasons, the classical explanations provided by Phelps (1972) and Arrow (1973) being '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, a situation that can turn into a "self-

fulfilling prophecy" if it decreases the expected returns on human capital investments made by immigrants (Aeberhardt and Pouget 2010: 119). In other words, due to employer beliefs or the limited transferability of credentials, immigrants may be penalized for difficulties in signaling their productivity. 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. A third theory on wage discrimination relates to differences in career dynamics, for instance if self-selection and self-censorship leads to immigrants behaving differently from native colleagues with identical productivity (Duguet et al. 2010: 7). These different mechanisms can be associated to the attributes of both being female and being foreign, so that female immigrants might cumulate wage penalties ("double discrimination").

Starting from these premises, it is obvious that empirical research needs data on wages but also on productivity to be able to assert the presence of discrimination against (female) immigrants. Recent advances in empirical research have provided at least three types of plausible explanations for why immigrants affect productivity differently than natives. These explanations can be divided into intrinsic productivity differences and segregation into groups with different productivity.

2.2. Sources for productivity differentials

2.2.1. Intrinsic productivity differences

Intrinsic productivity differences refer to the value of the human capital or ability of immigrants. They have been documented in studies on the language abilities of immigrants (Dustmann and van Soest 2002, Hellerstein and Neumark 2003), literacy

skills (Ferrer et al. 2006) or the quality and transferability of foreign education and training (Bratsberg and Ragan, 2002).

According to Friedberg (2000: 221), education and labor market experience acquired abroad are less valued than domestically acquired human capital. According to his study on the Israeli labor market, this difference can fully account for the wage penalty of immigrants compared to natives with similar characteristics. Bratsberg and Ragan (2002: 63) document a link between wage penalties and foreign education for the US. Their study suggests that this effect is either due to the inadequacy of foreign education or signaling problems and show that any additional schooling in the US "upgrades or certifies" the education previously acquired in the sending country. More recently, Aeberhardt and Pouget (2010: 130) found that education remains the most important explanations for wage differentials between native and foreign workers in the French wage distribution. Results in Dustmann and van Soest (2002) based on panel data from Germany show that language proficiency is considerably more important than what is conventionally assumed in the literature. A key result of this line of research is that a substantial portion of observed wage differentials is linked to intrinsic productivity differences, but also that wage penalties could diminish over time if intrinsic differences taper out in the assimilation process. A serious limitation of research in this area is that only few studies use direct information on productivity and investigate gender biases in intrinsic productivity differentials between immigrants and natives (Hellerstein and Neumark 2006; Bartolucci 2014).

2.2.2. Segregation into categories with different productivity

A second source of productivity differences between natives and immigrants can be subsumed under the concept of segregation, i.e. the non-random sorting into categories with different productivity. The most common categories associated with segregation include job types, tasks, occupational nomenclatures, firms with different technologies or capital endowments and sectors of activity. 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).

Bayard et al. (1999) argue that large parts of the wage gap between whites and non-whites in the US can be attributed to different types of labor market segregation. Elliott and Lindley (2008) conclude that occupational segregation contributes to immigrant-native wage gaps in the UK. Similarly, Aeberhardt and Pouget (2010: 118) find no wage discrimination but modest occupational segregation in their matched employer-employee data from France. Aydemir and Skuterud (2008) use Canadian matched employer-employee data to document non-random sorting of immigrants into firms that pay lower wages, an effect that appears to be stronger for immigrant men than for women. Peri and Sparber (2009: 135) use US Census data from 1960-2000 to show that foreign-born workers appear to specialize in manual and physically demanding occupations while natives sort into jobs requiring intensive communication and language skills, which can be interpreted as sorting into jobs with different productivity. Findings by Aslund and Nordstöm Skans (2010) suggest that path

dependency can explain part of heterogeneous sorting in Sweden as immigrants are more likely to work in firms which already employ immigrants.

Although segregation does not fall under 'wage discrimination' in the sense of Heckman's definition quoted above, recent research suggests that labor economists have overlooked that segregation not necessarily "explains" observed wage differentials. Firstly, studies using firm-level panel data on productivity conclude that it is not clear to what extent categories such as occupations are actually accurate proxies for productivity (Gottschalk 1978, Kampelmann and Rycx 2012). Indeed, none of the studies cited above use direct measures of productivity and therefore have to rely on more or less accurate proxies. Secondly, non-random sorting is hardly a satisfying explanation but rather points to structural differences in terms of origin or gender that call themselves for explanations. For instance, segregation raises equity issues if immigrants are systematically "downgraded" into low-wage categories that lie below their observed skills, as suggested in recent work by Dustmann et al. (2013) and McGuinness and Byrne (2014). As mentioned above, most available studies on gender or ethnic biases in segregation suffer from the absence of direct productivity measures (Hellerstein and Neumark 2006; Bartolucci 2014).

Female immigrants are potentially exposed to both intrinsic productivity differences and segregation into categories with lower productivity, again suggesting lower pay or, in the case of wages below marginal products, a risk of "double discrimination" for this group.

2.2.3. Institutional factors

Wage discrimination against groups such as women or foreigners can be either exacerbated or attenuated by institutional factors. In this context, different authors have hypothesised that collective bargaining 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; ETUC 2014). One way to assess the role of collective bargaining on wage discrimination is to use firm-level data for examining whether productivity-adjusted wage effects related to 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 firm level. According to the standard hypothesis on multi-level bargaining, we expect that wage discrimination is more likely to occur in firms *without* firm-level bargaining (Dell'Aringa et al 2004; Plasman et al. 2007).

A second hypothesis associated with institutional factors relates to the role of firm size. According to Lallemand and Rycx (2006), the wage bargaining process could be more likely to allow for wage discrimination if firms are relatively small. The main argument for this prediction is that larger firms tend to have more efficient and transparent human resource management, including clearly defined pay scales and job evaluation criteria. This being said, the effect of firm size could also magnify discrimination due to a general tendency that larger firms have been shown to be more unequal in terms of pay (Ferrer and Lluis 2008). Moreover, larger firms generally have

a larger range of occupational and job categories that could make it easier to associate a specific group with a specific category and pay scale. For example, the clustering of foreign workers in specially created low-pay job categories in large companies has been documented for the case of Turkish immigrants in German car factories during the 1970s (Kampelmann 2011). Smaller firms typically have less detailed job nomenclatures so that minority groups are less likely to be clustered in discriminated categories. In order to examine which of these mechanisms predominates, we have estimated the effect of firm size by splitting the sample into firms below and above the median firm size (which equals 57 workers in our dataset).

As for the preceding issues of intrinsic productivity differences and segregation, we have tested the hypotheses regarding institutional factors with firm-level data from Belgium that controls for productivity and a wide range of observable and non-observable characteristics.

3. Measurement methods

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 potential wage discrimination against immigrants. As a tool for disentangling productivity and wage discrimination, the standard version of the Oaxaca-Blinder decomposition has attracted increasingly sharp criticism (Hellerstein and Neumark 2006). 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: 119). 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: 3) 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."

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 Vandenberghe (2011a,b) 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 (Garnero et al. 2014a,b; 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 Hellerstein-Neumark method 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-Neumark 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: 9) 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 theme in the micro-econometric literature (Olley and Pakes 1996; Petrin et al 2004; Ackerberg et al. 2006). 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-Neumark 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 or Levinson-Petrin 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 new solution 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.[i]

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

$$\log\left(\overline{w}_{j,t}\right) = \alpha_j + \beta \log\left(\overline{p}_{j,t}\right) + \gamma\, I_{j,t} + \lambda\, X_{j,t} + \varepsilon_{j,t} \tag{1}$$

where the dependent variable $\log\left(\overline{w}_{j,t}\right)$ is the logarithm of the average hourly wage in firm j in year t; the variable $\log\left(\overline{p}_{j,t}\right)$ the logarithm of average hourly productivity; I_{jt} is the proportion of immigrants and γ the parameter that captures wage discrimination; X_{jt} is a vector containing a set of observable characteristics of firm j and its labour force in year t. In addition to Equation 1, we estimate a second equation that distinguishes between the proportions of male immigrants, female immigrants and female natives (respectively denoted as IM_{jt}, IW_{jt} and NW_{jt} – male natives are the reference category):

$$\log\left(\overline{w}_{j,t}\right) = \alpha_j + \beta \log\left(\overline{p}_{j,t}\right) + \gamma_{IM}\, IM_{j,t} + \gamma_{IW}\, IW_{j,t} + \gamma_{NW}\, NW_{j,t} + \lambda\, X_{j,t} + \varepsilon_{j,t} \tag{2}$$

3.2. Estimation methods

Equations 1 and 2 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 and 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; Daerden 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 shares of immigrant workers with their lagged levels. The implicit assumption is that changes in wages in one period, although possibly correlated with contemporaneous variations in the shares of immigrant workers, are unrelated with lagged levels of the latter. Moreover, changes in the shares of immigrant workers are assumed to be sufficiently correlated to their past levels. The second instrument is the annual average share of immigrants in the sector

in which firm *j* operates.[ii] The rationale for this instrument is that sector shares can be shown to be correlated with the proportion of immigrants in firm *j* while being unrelated to the productivity of firm *j* and the error term (Garnero 2014).

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 immigrant shares are indeed endogenous so that an IV approach is warranted. Under the null hypothesis the explanatory variables can actually be treated as exogenous.

4. Data and descriptive statistics

4.1. Data set

Our empirical analysis is based on a combination of two large data sets spanning the period 1999-2010. The first is the Structure of Earnings Survey (SES). It 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 a wealth of information, provided by the human resource departments of

firms, both on the characteristics of the latter (e.g. sector of activity, number of workers, level of collective wage bargaining) and on the individuals working there (e.g. age, education, gross earnings, paid hours, gender, occupation, etc).[iii] The SES provides no financial information. Therefore, it has been merged with a firm-level survey, the Structure of Business Survey (SBS). The SBS provides information on financial variables such as firm-level added value and gross operating surplus per hour. 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 firms' 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.

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.[iv] 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.[v]

Our final sample consists of an unbalanced panel of 9,430 firms and 555,963 individuals, yielding 23,712 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).

4.2. Definition of main variables

Our earnings measure 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 is measured at factor costs and based on the total number of hours effectively worked by the firm's employees. 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 OECD statistics on immigration we cited in the introduction define immigrants as individuals who reside in a different country than the one in which they were born. For at least three reasons this is an imperfect indicator for the presence of immigrants on the labor market. First, some of the "otherness" of foreign-born workers is erased through the process of assimilation: an individual who was born abroad but who spent her entire adult life in the host country is often so assimilated that she ceases to be an "immigrant" in the eyes of her employer, co-workers and even herself. Second, the children of foreign-born immigrants are by this definition not counted as "immigrants" even though they are often perceived as such in their host society. Third, while all immigrants differ to some extent from natives – even if only by the country of birth in their passport – some immigrants differ more from natives than others: a German in Austria or a Frenchman in Belgium arguably stands less out than a Turkish or a Moroccan.

In the literature on wage discrimination against immigrants, most studies operationalize the distinction between immigrants and natives by using information on the country of birth and/or the nationality of the individual. For instance, Böheim et al. (2012: 15) distinguish between Austrian-born workers and those born in any other country. The authors use country of birth rather than nationality on the grounds that "ethnic background may be more relevant for productivity spillovers than citizenship". As argued above, the simple native-immigrant dichotomy is problematic because it does not account for the unequal otherness of immigrants: for instance, it does not distinguish between the different socio-economic status of German and Turkish immigrants in Austria. Another problem with this definition is that "being an immigrant" can be associated with both the country of birth and the nationality of an individual.

For the case of Belgium, existing evidence suggests that we can address the problem of heterogeneity among immigrants by distinguishing between individuals from the European Union and those from outside of the EU. Martens et al. (2005) show that workers born in Morocco and Turkey are underrepresented in high-wage jobs, whereas those from Western or Northern Europe are not. Similarly, recent studies by the Institute for the Equality of Women and Men (2010, 2012) find that the distinction between EU and non-EU workers is highly relevant for explaining wage differences in Belgium. Moreover, using the criterion of EU membership has the advantage of higher policy relevance than the simple native-immigrant dichotomy since immigration policy in EU Member States cannot regulate the flow of workers with EU nationality due to the EU Directive on the right to move and reside freely. A consequence of this Directive is that Member States can only influence non-EU flows, for instance via quotas, visa, asylum policies etc.

In this paper, we present results based on two mutually exclusive groups that define immigrants as a combination of both nationality and country of birth. The first group – "EU workers" – consists of individuals who were born in a Member State of the European Union and with an EU nationality. EU membership evolved over time in successive waves of accession. We show results based on EU-15 Member States, but our results are robust to this choice due to the still relatively low share of workers from accession countries in Belgium. The biggest difference concerns Polish workers, who represent 2.8 % of non-EU individuals according to our EU-15 criterion and would be counted as EU members with an EU-28 definition. Our baseline results are also robust to using only country of birth or only nationality to define non-EU employees.

In our sample, 91.8% of individuals are thus labelled as EU employees. Within this group, individuals born in Belgium represent the largest share (93.9%), followed by France (1.7%), Italy (1.5%), Germany (0.8%) and the Netherlands (0.7%). The second group – "non-EU workers" – consists of individuals who were either born outside of the EU or with a non-EU nationality, which is the case for 8.2% of observations. The most frequent country of birth in this group is Morocco (21.3%), Belgium (20.9% of non-EU workers were born in Belgium but with a non-EU nationality), Turkey (12.6%), Congo (7.7%) and Serbia (4.1%).

Male and female non-EU workers represent respectively 6.4% and 1.8% of the sample (35,690 and 9,999 observations). This equals a gender ratio of 22% among non-EU workers and 27% among EU workers. It should be noted that the relatively small share of women in the sample is not a bias but merely reflects the fact that women are underrepresented in the Belgian private-sector economy on which we focus in this paper.

4.3. Individual-level statistics

Table 1 shows descriptive statistics for EU and non-EU employees over the period 1999-2010. In order to examine gender differences within these two groups, we show separate means for men and women. The average hourly wage is the highest for EU men (16.3 euros) and lowest for non-EU women (13.4 euros). On average, EU women and non-EU men earn roughly the same (around 14.25 euros). The average wage for the entire sample is 15.6 euros and the average wage gap between immigrants and natives 11%; the immigrant-native gap is 14.8% among men and 6.7% among women. However, these averages mask the distribution of wages within each group. The density plots in Figure 1 show that the distribution of non-EU men and women (black curves) is more compressed compared to EU workers (grey curves). Moreover, the density curves of both EU and non-EU women (solid lines) peak at lower hourly wages compared to the curves of both male groups (dashed lines), but the curve for EU women (in grey) lies above the curve for non-EU men (in black) for wages above 16 euros.

[Insert Figure 1 about here]

Table 1 underlines why it is important to take differences in human capital and sorting into jobs, firms, sectors and regions into account. Indeed, the four groups under analysis have distinct statistical profiles. Women in our sample are on average better educated than men, although the difference between non-EU women and EU men is only small. Non-EU men are by far the group with the lowest human capital from schooling. Another indicator for human capital is labour market experience, which in

our data can be (imperfectly) proxied through the employee's tenure with her current employer. More than half of EU men and women have more than five years of experience with their current employers, whereas this holds only for 38% of non-EU men and less than 30% of non-EU women. Foreigners and natives also differ with respect to the type of contracts on which they are employed: the proportion of fixed-term contracts is very small among men from the EU (2.5%) and 5.7 percentage points lower compared to non-EU women.

The group of immigrants is on average younger compared to natives, with EU men being the oldest and non-EU women the youngest group in the sample. The occupational distribution reflects both the gender dimension and immigrant status: both EU and non-EU men are overrepresented in crafts and among machine operators. While there are more EU men in managerial positions and among professional and technical occupations, non-EU men are relatively more frequent in service and elementary occupations. Women are overrepresented in clerical, service and elementary occupations, whereas non-EU women are more concentrated in elementary and EU women in clerical occupations. The biggest differences in the sectoral distribution of men and women are found in the predominantly male construction sector; in the overrepresentation of women in wholesale and retail trade as well as in real estate, renting and business services. Immigrants are overrepresented in the hotel and restaurant sector. Non-EU women are strongly underrepresented in manufacturing. Whereas foreign men work on average for relatively small firms (measured in terms of the size of the workforce), foreign women work in larger firms. Firm-level collective bargaining is more prevalent in firms with a more masculine workforce: only 14% of non-EU women are employed in firms that renegotiate wages through firm-level bargaining, a proportion that is 6.8 percentage points lower compared to EU men.

Finally, Table 1 shows the relative concentration of immigrants in the Brussels region and their marked underrepresentation in Flanders.

[Insert Table 1 about here]

A simple way to explore these descriptives is to apply the conventional method for disentangling the productivity effects and wage discrimination by regressing human capital and compositional characteristics on the logarithm of individual hourly wages. In our sample, an OLS Mincer equation[vi] yields a coefficient of determination of 54% and a negative and significant coefficient for the non-EU dummy equal to -0.04, thus suggesting that a non-EU worker whose observed characteristics are identical to a EU worker suffers from a wage penalty of 4%. This is in line with results from an Oaxaca-Blinder decomposition which indicates that around 77% of the gross wage gap in our sample can be attributed to observable differences. The highest contribution to the explained part in the Oaxaca-Blinder decomposition comes from individual and job characteristics (60.1% of the explained wage gap), while firm characteristics also matter (31%). Introducing interaction variables between immigrant status and gender improves the fit of the OLS Mincer equation: the coefficient of determination rises by 3 percentage points and all three interaction variable are highly significant. Compared to the reference group of EU men, the ceteris paribus wage penalty of non-EU men remains at around 4%. Women appear to suffer from relatively higher discrimination because the respective coefficients for non-EU and EU women are -0.15 and -0.14 (all three interaction coefficients are significantly different from each other). As explained above, however, these results suffer from severe methodological issues and need to be complemented with more sophisticated identification techniques.

4.4. Firm-level statistics

Our identification strategy uses information on individual worker and job characteristics with matched data on their employers, including average hourly productivity in the firm.

While the composition of firms in terms of observable individual and job characteristics does not differ substantially from the individual-level descriptive statistics (see last column in Table 1), firm-level data allow to assess the distribution of EU and non-EU workers across firms (Aydemir and Skuterud 2008). According to Mitaritonna et al. (2014), insufficient attention has been paid to the large share of firms that do not hire any immigrants. The highly unequal distribution that Mitaritonna et al. (2014) observe in France echoes findings by Böheim et al. (2012: 15) for Austria suggesting that "the employment of foreign workers is concentrated in few firms, about 50 percent of firms employ less than 15 percent of foreign workers and 10 percent of firms employ more than 50 percent of immigrant workers". In line with these studies, immigrants are found in only 53% of firm-year observations in our sample from Belgium.[vii]

The concentration of immigrants has been attributed to non-random sorting, for instance due to network effects (Aslund and Nordstöm Skans 2010). Adding the gender dimension to the analysis of non-random sorting sheds further light on the issue. In our sample, the presence of non-EU men is positively correlated with the presence of non-EU women (the corresponding significant pair-wise correlation coefficient is 0.15), whereas the share of both groups is negatively correlated to the share of EU men (the significant correlation coefficients are -0.30 between non-EU and EU men and -0.42 between non-EU women and EU men).

For our identification strategy based on Equations 1 and 2, the concentration of immigrants is potentially problematic if firms with no immigrants differ from the other firms in terms of some unobserved characteristic that is correlated with differences in labor productivity. In order to evaluate the relevance of this issue in our sample, we have estimated a logistic regression in which a dummy variable that equals 1 if there are any immigrants in the firm is regressed on firm composition and firm characteristics. The corresponding pseudo-coefficient of determination equals 8.5% and the log pseudolikelihood -15003.8. Importantly, neither the coefficient for the average hourly productivity nor the share of women in the firm is significantly correlated with the presence of immigrants in the firm. A significantly positive relationship is found for the regional dummies for Brussels and Wallonia (in line with the higher presence of immigrants in these regions compared to the reference region Flanders); the share of young workers; and the size of the firm. The sectoral and occupational composition of the firm is not always significant in the logistic regression. As a consequence, immigrants do not appear to be sorted according to differences in hourly productivity between firms, but rather according to region, age and size, i.e. variables consistent with sorting according to networks (Dustmann et al. 2011).

[Insert Figure 2 about here]

Figure 2 shows the distribution of firms with respect to their respective shares of male and female immigrants (the plot is restricted to the firm-year observations employing any non-EU workers). We observe that both distributions are highly skewed and illustrate that the vast majority of firms have less than 20% of immigrants

on their payroll; only very few firms are composed of more than 40% and virtually none of more than 80% of immigrants.

5. Estimation results

5.1. Baseline regressions

Regression results for the Bartolucci firm-level wage-setting model are presented in Table 2. The first four columns show alternative specifications of a pooled OLS estimator in order to illustrate the impact of different forms of observed heterogeneity. The wage gap between EU and non-EU employees is captured by the parameter γ. In the first model without control variables, this corresponds to the gross wage differential and is estimated to be -0.24, i.e. a 10 percentage point increase in the share of immigrants is on average associated with a 2.4% decrease (= 0.1*-0.24) of the average hourly wage in Belgian firms. This effect collapses once we include observed individual and job characteristics: the same increase in the immigrant share is now associated with an insignificant decrease in average wages, whereas a 10 percentage point rise in the share of female workers is related to a 1.9% drop in wages. Segregation of workers across sectors and regions affects the immigrant and female wage penalties only marginally (column 3). The full-blown specification of Equation 1 includes the average hourly productivity in the firm and other firm-level control variables (firm size, capital stock and level of wage bargaining) on the right-hand side (column 4). The productivity parameter β is positive and significant and the inclusion of observed firm characteristics increases the coefficient of determination by 5 percentage points. However, the coefficient capturing wage discrimination against

immigrants remains insignificant, while the female wage penalty is slightly reduced but remains high (the significant coefficient equals -0.17).

[Insert Table 2 about here]

The specifications in columns 5 and 6 take into account unobserved time-invariant firm heterogeneity, i.e. some of the differences between firms that could be related to hourly wages (and hourly productivity) and therefore bias the OLS results. The fixed-effect model (column 5) shows a small and significant immigrant wage penalty (a 10 percentage point increase in the share of immigrants is associated with a 0.2% decrease in the average wage), and the wage coefficient of women is reduced by almost 50% to -0.09. Unobserved time-invariant firm heterogeneity appears to be highly correlated with hourly labor productivity since the associated coefficient remains significant but decreases to 0.01.[viii] The GMM-IV estimator (column 6) not only takes firm-level heterogeneity into account through its specification in first differences, but also addresses the potential endogeneity of the firm's labor force by using the lagged levels and average industry shares as instruments. Applying GMM-IV yields an insignificant wage penalty for immigrants and a somewhat higher (and significant) wage penalty for women (the corresponding coefficient equals -0.13). A series of statistical tests suggests that our instruments are valid and that the model is correctly identified: the model passes the tests for under-, weak- and overidentification. However, the endogeneity test indicates that the potentially endogenous worker shares can actually be treated as exogenous (the p-value equals 54%), which means that the fixed-effect model should be preferred.

As argued in Section 3, the coefficients in the Bartolucci wage equation can be interpreted as productivity-adjusted measures of discrimination of certain groups of employees. Complementary evidence on this issue can be obtained by focusing on the productivity effect of the share of foreigners in the conventional Hellerstein-Neumark approach. Annex 1 presents such productivity equations for OLS, FE and GMM-IV estimators. While OLS coefficients suggest significantly negative effects on productivity for both foreigners and women, the inclusion of time-invariant unobservable firm characteristics renders the coefficients insignificantly different from zero. This corroborates the finding of the Bartolucci wage equation that some of the lower pay received by foreigners and (especially) women is due to discrimination and not to measurable differences in labour productivity.

5.2. Interactions between foreigner and gender variables

Table 3 reproduces Table 2 but the estimated models now allow for the respective effects of non-EU men, non-EU women and EU women to differ. Relative to the reference group of EU men, the significant gross wage differential in the parsimonious OLS estimator (column 1) is the highest for non-EU men (a 10 percentage point increase of this group is associated with a 2.9% drop of the average firm wage), followed by non-EU women (-1.2%) and EU women (-0.8%). This order arguably reflects both the sorting of non-EU men into low-productivity firms and the fact that this group has the lowest level of human capital (see Table 1). The order is indeed inverted once we control for observed individual and job characteristics (column 2). Segregation into sectors and regions accounts for around 40% of the gross wage

penalty for non-EU women (column 3), but is less consequential for non-EU men and EU women.

[Insert Table 3 about here]

Adding average hourly productivity and firm-level characteristics to the model slightly reduces the relative wage penalty for EU women (column 4). The GMM-IV estimator (column 6) again passes our identification tests but also rejects the endogeneity of the worker shares so that the fixed-effect estimator (column 5) is our preferred model. It suggests that the ceteris paribus wage penalty is the highest for EU women (a 10 percentage point increase in EU-women is associated with a 1% lower hourly wage), followed by the penalty for non-EU women (-0.6%), but the difference between the two coefficients is not statistically significant. By contrast, the wage coefficient for non-EU men equals -0.03 and is significantly lower compared to the penalty against EU women.

5.3. Institutional factors

We now turn to the results pertaining to the discussion of institutional factors in Section 2.2.3. In order to assess the effect of collective bargaining regimes, Table 4 shows the OLS, FE and GMM-IV estimators including all control variables for two sub-samples: 19.803 firm-year observations in which no firm-level collective bargaining has taken place and 3.909 observations with firm-level bargaining. Contrary to the estimation results presented above, the GMM-IV estimator is the preferred specification for the subsample without firm-level bargaining for which we cannot

reject the hypothesis of endogenous labour shares (the endogeneity test returns a p-value of 0.06 against the null hypothesis of exogenous regressors). For the other subsample the FE estimators remains the preferred specification.

[Insert Table 4 about here]

The results provide some evidence for wage discrimination against foreigners in firms without establishment-level collective bargaining: a 10 percentage-point increase is correlated with 2% lower average wages in the preferred GMM-IV regression. By contrast, the corresponding coefficient in the subsample with establishment-level collective bargaining is not significantly different from zero. The difference between the two subsamples with respect to the foreigner coefficient is statistically significant.

As for the coefficient related to the share of female employees, both subsamples display negative coefficients of roughly the same magnitude as in the baseline regression. Comparing the preferred estimators, the difference between the two bargaining regimes is not significant. Additional regressions including interaction variables between gender and foreigner status (not shown here but available upon request) also confirm previous results of wage penalties against both foreigners and women as well as the absence of significant double discrimination against foreign women.

[Insert Table 5 about here]

The second factor discussed in Section 2.2.3 is firm size. Table 5 shows results for two subsamples distinguishing the 11.927 firm-year observations below the median

firm size ("small firms") from the 11.785 observations above the median ("big firms"). In none of the two subsamples we find evidence for endogenous regressors so that the FE estimator is our preferred specification. Whereas the coefficient for the share of foreigners is not statistically different from zero in small firms, the estimation suggests that a 10% increase of foreigners is associated with 0.4% drop of the average wage in big firms. The difference between the two subsamples with respect to the foreigner coefficient is significant. Regarding the coefficients for gender, Table 5 again produces similar results compared to the baseline specification and additional regressions with interaction variables (not shown) provide no evidence for significant double discrimination of female foreigners.

6. Discussion and conclusion

This paper is one of the first to use firm-level matched employer-employee data and direct information on wages and labor productivity to measure discrimination against immigrants. We build on a recent identification strategy proposed by Bartolucci (2014) and address econometric issues such as firm fixed effects and the potential endogeneity of worker shares through a diff GMM-IV estimator. Our preferred estimator of a Bartolucci-type wage-setting equation (the fixed-effect model shown in column 5 of Table 2) suggests that an increase in the share of non-EU workers in a firm is correlated with a modest but significant decrease of the average wage paid in Belgian firms.

The wage coefficient associated with the share of women is also significantly negative and three times higher compared to the wage discrimination against non-EU workers. However, wage discrimination against immigrants is likely to interact with gender discrimination – an important contribution of the paper is therefore to estimate

these interactions. Our preferred model including interactions between gender and immigrant status (column 5 in Table 3) corroborates modest wage discrimination against men of non-EU origin, but also shows that the wage discrimination against both native and foreign women is significantly higher. Results suggest that origin is not associated with a significantly different wage penalty among women: we therefore find evidence for significant wage discrimination against immigrants and women, but female immigrants do not appear to be exposed to "double-discrimination" by employers in Belgium. This result stands up to a series of tests, including measurement issues such as unobserved time-invariant firm heterogeneity, the potential endogeneity of the firm composition, but also to alternative definitions of the immigrant status and the reduction of our sample to firm-year observations with at least one immigrant per firm.

We also test additional hypotheses regarding institutional factors that could influence the extent of wage discrimination against foreigners and/or women. The first hypothesis relates to the role of the collective bargaining regime. We find evidence that firm-level bargaining seems to eliminate the incidence of wage discrimination against foreigners (see Table 4). This lends some support to the often expressed argument that trade unions strive to protect low-wage groups from unfair pay (cf. Dell'Aringa et al 2004), but also that this protection appears to be only effective at lower levels of bargaining. In Belgium, virtually all firms are covered by national and sectoral collective bargaining agreements, yet only those that engage in additional renegotiation of wages within individual companies – which is the case for around 16.5% of the firms in our sample – seem to curb wage discrimination against foreigners. The second hypothesis concerns the effect of firm size. Our results (Table 5) suggest that wage discrimination against foreigners is concentrated in relatively large firms. This speaks

against the capacity of more sophisticated human resource management practices, according to Lallemand and Rycx (2006) a characteristic of large firms, to attenuate wage discrimination against foreigners. By contrast, our results are in line with the generally observed high wage inequality in big firms. It is also coherent with the explanation that larger firms harbour special low-pay categories in which foreigners are clustered – a practice that was documented in the German manufacturing sector during the first wave of massive post-war immigration (Swenson 1989; Kampelmann 2011) and that could have survived in large firms until today. On any account, the regressions capturing specific institutional contexts corroborate significant and sizable discrimination against women and the absence of significant double discrimination against foreign women.

Due to the novelty of the approach we can only compare our findings to results for Germany by Bartolucci (2014), who also finds negative productivity-adjusted wage coefficients for male and female immigrants as well as native women. The size of wage discrimination found by Bartolluci is also relatively modest but somewhat higher compared to our results: a 10 percentage point increase in the share of male immigrants is associated with a 1.3% decrease in the average firm wage in Germany, whereas we find a 0.2% decrease for Belgium. Unlike our estimations, however, Bartolucci (2014) finds evidence for double-discrimination against female immigrants in Germany (a 10 percentage point increase in female immigrants is associated with a 2.7% lower average firm wage).

Our results suggest that not all of the observed wage differences between immigrants and natives are due to productivity differences (for instance due to lower language skills) – despite Belgian's strong anti-discrimination legislation we find evidence for wage discrimination against immigrants. The wage gap between women

and men can also not be reduced to productivity differences – and compared to the native-immigrant gap there is arguably a lower theoretical case for productivity differences between men and women to begin with. Interestingly, foreign women do not cumulate the two wage penalties associated to gender and origin and receive roughly the same wage penalty as native women. A possible explanation for this phenomenon might by that origin is of lesser importance among women than among men; indeed, the educational profile of women with foreign origin resembles closely the one of native women. Moreover, certain institutional factors such as firm-level collective bargaining and smaller firm sizes appear to attenuate wage discrimination against foreigners, but not against women. Overall, our results suggest that while wage discrimination against immigrants remains an issue on the Belgian labor market, the magnitude of this discrimination is relatively small compared to the discrimination against (native and foreign) women.

7. References

Ackerberg, D., Caves, K. and Frazer, G. (2006). 'Structural identification of production functions'. *MPRA Working Paper* 38349, UCLA.

Aeberhardt, R., Fougère, D., Pouget, J. and Rathelot, R. (2010). 'L'emploi et les salaires des enfants d'immigrés'. *Economie et Statistique*, 433-434: 31-46.

Aeberhardt, R. and Pouget, J. (2010). 'National origin differences in wages and hierarchical positions: Evidence on French full-time male workers from a matched employer-employee dataset'. *Annals of Economics and Statistics*, 99(100): 117-139.

Altonji, J. and Blank, R. (1999). 'Race and gender in the labor market', in O. Ashenfelter and D. Card (eds.), *Handbook of Labor Economics*, 3C, chap. 48: 3143-3259.

Arai, M. and Nekby, L. (2007), 'Gender and ethnic discrimination: An introduction', *Swedish Economic Policy Review*, 14(1): 3-6.

Arai, M. and Thoursie, P. (2009). 'Renouncing personal names: An empirical examination of surname change and earnings'. *Journal of Labor Economics*, 27(1): 127-147.

Arai, M., Bursell, M. and Nekby, L. (2015). 'The reverse discrimination: Employer stereotypes of men and women with Arabic names', *International Migration Review*, forthcoming.

Arrow, K. (1998). 'What has economics to say about racial discrimination'. *Journal of Economic Perspectives*, 12: 91-100.

Aslund, O. and Skans, O. (2010). 'Will I see you at work? Ethnic workplace segregation in Sweden, 1985-2002'. *Industrial and Labor Relations Review*, 63(3): 471-493.

Aubert, P. and Crépon, B. (2003). 'La productivité des salariés âgés : une tentative d'estimation'. *Economie et Statistique*, 368: 95-119.

Aydemir, A. and Skuterud, M. (2008). 'The immigrant wage differential within and across establishments'. *Industrial and Labor Relations Review*, 61(3): 334-352.

Baert, S. and Cockx, B. (2013). 'Pure ethnic gaps in educational attainment and school to work transitions. When do they arise?'. *Economics of Education Review*, 36, 276-294.

Baert, S., De Pauw, A. (2014). 'Is ethnic discrimination due to distaste or statistics?'. *Economics Letters*, 125, 270-273.

Baert, S., Heiland, F., Korenman, S. (2014). 'Native-immigrant gaps in educational and school-to-work transitions in the second generation: The role of gender and ethnicity'. *IZA Discussion Paper* No. 8752, Bonn.

Baert, S., Cockx, B., Gheyle, N. and Vandamme, C. (2015), 'Is there less discrimination in occupations where recruitment is difficult', Industrial and Labor Relations Review, 68(3): 467-500.

Barrett, A., McGuinness, S. and O'Brien, M. (2012). 'The immigrant earnings disadvantage across the earnings and skills distributions: The case of immigrants from the EU's new member states in Ireland'. British Journal of Industrial Relations, 50(3): 457-481.

Bartolucci, C. (2014). 'Understanding the native-immigrant wage-gap using matched employer-employee data: Evidence from Germany'. *Industrial and Labor Relations Review*, 67(4): 1166-1202.

Bayard, K., Hellerstein, J., Neumark, D. and Troske, K. (1999). 'Why are racial and ethnic wage gaps larger for men than for women? Exploring the role of segregation', in J.Haltiwanger, J.Lane, J.Spletzer, J.Theeuwes and K.Troske, eds, *The Creation and Analysis of Employer-Employee Matched Data*, Elsevier.

Becker, G. (1957). *The Economics of Discrimination*, Chicago: University of Chicago Press.

Bevelander, P. and Veenman, J. (2008). 'Naturalisation and socioeconomic integration: The case of the Netherlands', in Bevelander, Pieter and D.J. DeVoretz (eds.), *The Economics of Citizenship*, Malmo University, Malmö: Holmbergs, Sweden.

Black, S. and Lynch, L. (2001). 'How to compete: The impact of workplace practices and information technology on productivity'. *Review of Economics and Statistics*, 83(3): 434-445.

Blinder, A. (1973). 'Wage discrimination: Reduced form and structural estimates'. *Journal of Human Resources*, 8: 436-455.

Böheim, R., Horvath, T. and Mayr, K. (2012). 'Birthplace diversity of the workforce and productivity spillovers in firms'. *WIFO Working Papers* 438, Vienna.

Borjas, G. and Katz, L. (2007). 'The evolution of the Mexican-born workforce in the United States', In: *Mexican Immigration to the United States*, edited by George Borjas. National Bureau of Economic Research Conference Report, Cambridge, MA.

Bratsberg, B. and Ragan, J. (2002). 'The impact of host-country schooling on earnings'. *Journal of Human Resources*, 37(1): 63-105.

Cahuc, P. and Zylberberg, A. (2004). *Labor Economics*, Cambridge (Ma.): MIT Press, 844p.

Chiswick, B. (1978). 'The effect of Americanization on the earnings of foreign-born men'. *Journal of Political Economy*, 69: 897-921.

Chiswick, B., Le, A. and Miller, P. (2008). 'How immigrants fare across the earnings distribution in Australia and the United States'. *Industrial and Labor Relations Review*, 61(3): 353-373.

Daerden, L., Reed, H. and Van Reenen, J. (2006). 'The impact of training on productivity and wages: Evidence from British panel data'. *Oxford Bulletin of Economics and Statistics*, 68(4): 397-421.

Dell'Aringa, C. and Lucifora, C. (1994). 'Wage dispersion and unionism: do unions protect low pay?' *International Journal of Manpower*, 15(2/3): 150-169.

Dell'Aringa, C., Lucifora, C., Orlando, N. and Cottini, E. (2004). 'Bargaining structure and intra-establishment pay inequality in four European countries: Evidence from matched employer-employee data.' In *PIEP Working Paper, CEP-LSE*.

Duguet, E., L'Horty, Y., Meurs, D. and Petit, P. (2010). 'Measuring discriminations: An introduction'. *Annals of Economics and Statistics*, 99/100: 5-14.

Dustmann, C., Frattini, T. and Preston, I. (2013). 'The effect of immigration along the distribution of wages'. *Review of Economic Studies*, 80(1): 145-173.

Dustmann, C., Glitz, A. and Schönberg, U. (2011). 'Referral-based job search networks', *IZA Discussion Papers* 5777, Bonn.

Dustmann, C. and van Soest, A. (2002). 'Language and the earnings of immigrants'. *Industrial and Labor Relations Review*, 55(3): 473-492.

Elliott, R. and Lindley, J. (2008). 'Immigrant wage differentials, ethnicity and occupational segregation'. *Journal of the Royal Statistical Society*, Series A 171(3): 645-671.

Ferrer, A., Green, D. and Riddell, C. (2006). 'The effect of literacy on immigrant earnings'. *Journal of Human Resources*, 41(2): 380–410.

Ferrer, A. and Lluis, S. (2008). 'Should workers care about firm size?. *Industrial and Labor Relations Review'*, 62(1): 104-125.

Freeman, R. (1980). 'Unionism and the dispersion of wages'. *Industrial and Labor Relations Review*, 34(1): 3-23.

Friedberg, R. (2000). 'You can't take it with you? Immigrant assimilation and the portability of human capital'. *Journal of Labor Economics*, 18(2), 221-251.

Garnero, A. (2014). *Institutions and Heterogeneity in the Labor Market. Doctoral dissertation in economics*, Ecole Normale Supérieure (ENS), Paris.

Garnero, A., Kampelmann, S. and Rycx, F. (2014a). 'Part-time work, wages and productivity: Evidence from Belgian matched panel data'. *Industrial and Labor Relations Review*, 67(3): 926-954.

Garnero, A., Kampelmann, S. and Rycx, F. (2014b). 'The heterogeneous effects of workplace diversity on productivity, wages and profits'. *Industrial Relations: A Journal of Economy and Society*, Vol. 53, No. 3, pp. 430-477.

Göbel, C. and Zwick, T. (2012). 'Age and productivity: Sector differences'. *De Economist*, 160(1): 35-57.

Gottschalk, P. (1978). 'A comparison of marginal productivity and earnings by occupation'. *Industrial and Labor Relations Review*, 31(3): 368-378.

Heckman, J. (1998). 'Detecting discrimination'. *Journal of Economic Perspectives*, 12 (2): 101-116.

Hellerstein, J., Neumark, D. and Troske, K. (1999). 'Wages, productivity and workers characteristics: Evidence from plant-level production functions and wage equations'. *Journal of Labor Economics*, 17: 409-446.

Hellerstein, J. and Neumark, D. (2003). 'Ethnicity, language, and workplace segregation: Evidence from a new matched employer-employee data set'. *Annals of Economics and Statistics*, 71-72:19-78.

Hellerstein, J. and Neumark, D. (2006). 'Using matched employer-employee data to study labor market discrimination', in W. Rodgers (ed.), *Handbook on the Economics of Discrimination*, Great Britain: Edgar Elgar Publishing.

Institute for the Equality of Women and Men (2012). L'écart salarial entre les femmes et les hommes en Belgique : rapport 2012, Bruxelles, 87p.

Institute for the Equality of Women and Men (2010). How to close the gender pay gap? Strategies and good practices of states and social partners in Europe", Dépôt nr. D/2010/10.043/14, Brussels.

Kampelmann, S. (2011). *The Socio-economics of pay rules*. Doctoral dissertation in economics, Université Lille 1 and Université libre de Brussels, May 2011.
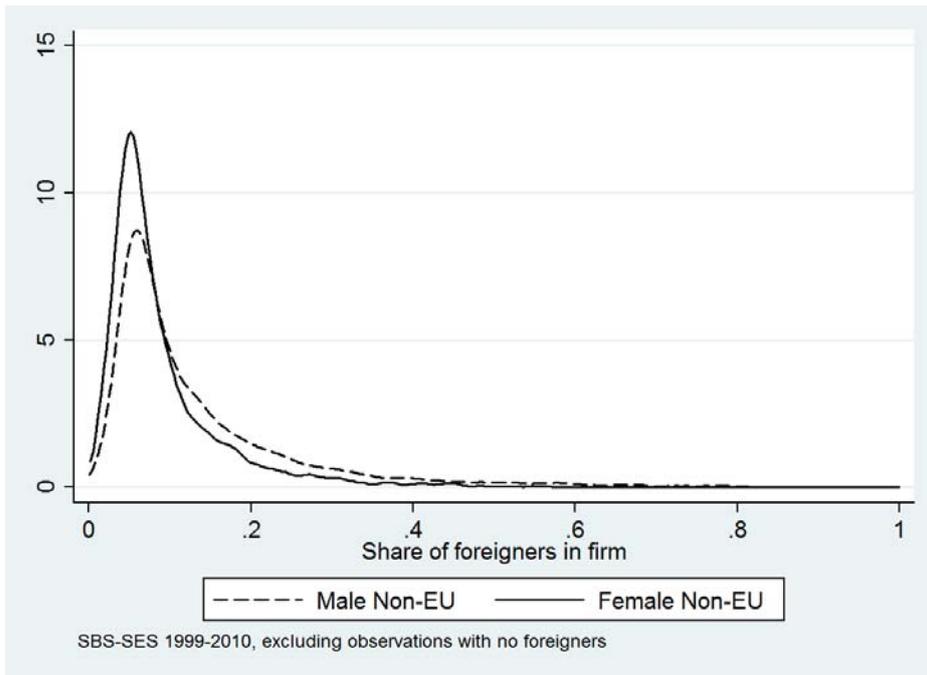
Kampelmann, S. and Rycx, F. (2012). 'Are occupations paid what they are worth? An econometric study of occupational wage inequality and productivity'. *De Economist*, 160(3): 257-287.

Lallemand, T. and Rycx, F. (2005). 'Establishment size and the dispersion of wages: Evidence from European countries.' *Applied Economics Quartely*, 52(4): 309-336.

Martens, A., Ouali, N., Van de Maele, M., Vertommen, S., Dryon, P. and Verhoeven, H. (2005). 'Discrimination des étrangers et des personnes d'origine étrangère sur le marché du travail de la Région de Bruxelles-Capitale'. *Rapport de synthèse pour l'ORBEM*, 110p.

McGuinness, S. and Byrne, D. (2014). 'Examining the relationships between labor market mismatches, earnings and job satisfaction among immigrant graduates in Europe'. *IZA Discussion Paper* 8440, Bonn.

Meurs, D. and Pailhe, A. (2010). 'Position sur le marché du travail des descendants directs d'immigrés en France : les femmes doublement désavantagées ?'. *Economie et statistique*, 431-432 : 129-151.

Mitaritonna, C., Orefice, G. and Peri, G. (2014). 'Immigrants and firms' productivity: Evidence from France'. *IZA Discussion Paper* 8063, Bonn.

Nicodemo, C. (2013). 'Immigration and labor productivity: New empirical evidence from Spain'. *IZA Discussion Paper* 7279, Bonn.

Oaxaca, R. (1973). 'Male-female wage differentials in urban labor markets'. *International Economic Review*, 14: 693-709.

OECD (2014). 'Is migration really increasing?' *Migration Policy Debates*, OECD, May 2014, 4p.

Olley, S. and Pakes, A. (1996). 'The dynamics of productivity in the telecommunications equipment industry'. *Econometrica*, 64(6): 1263–97.

Ottaviano, G. and Peri, G. (2012). 'Rethinking the effect of immigration on wages'. *Journal of the European Economic Association,* 10(1): 152-197.

Paserman, D. (2013). 'Do high-skill immigrants raise productivity? Evidence from Israeli manufacturing firms, 1990-1999'. *IZA Journal of Migration*, 2(6): 1-31.

Plasman, R., Rusinek, M. and Rycx, F. (2007). 'Wages and the bargaining regime under multi-level bargaining: Belgium, Denmark and Spain'. *European Journal of Industrial Relations*, 13(2): 161-180.

Petrin, A., Poi, B. and Levinsohn, J. (2004). 'Production function estimation in Stata using inputs to control for unobservables'. *Stata Journal*, 4(2): 113–23.

Salama, P. (2010). *Migrants et lutte contre les discriminations en Europe*. Strasbourg : Editions du Conseil de l'Europe.

Simon, H., Ramos, R. and Sanroma, E. (2014). 'Immigrant occupational mobility: Longitudinal evidence from Spain', *European Journal of Population*, 30(2): 223-255.

Swenson, P. (1989). *Fair shares: Unions, pay, and politics in Sweden and West Germany*. Ithaca: Cornell University Press.

Van Ours, J. and Stoeldraijer, L. (2011). 'Age, wage and productivity in Dutch manufacturing'. *De Economist*, 159(2): 159-92.

Vandenberghe, V. (2011a). 'Firm-level evidence on gender wage discrimination in the Belgian private economy'. *LABOUR*, 25(3): 330-349.

Vandenberghe, V. (2011b). 'Boosting the employment rate of older men and women: An empirical assessment using Belgian firm-level data on productivity and labour costs'. *De Economist*, 159(2): 159-191.

Vandenberghe, V. (2013). 'Are firms willing to employ a greying and feminizing workforce?'. *Labour Economics*, 22: 30-46.

Figure 1: Distribution of hourly wages by immigrant status and gender

gross wages SBS 1999-2010, excluding outliers
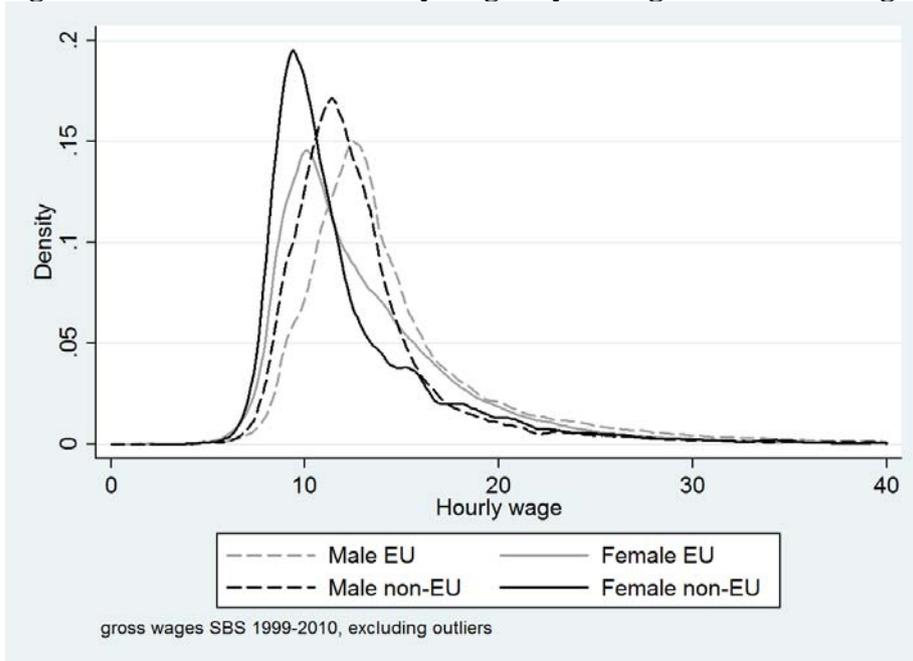
Figure 2: Distribution of immigrant shares by gender

SBS-SES 1999-2010, excluding observations with no foreigners

Table 1: Sample means by foreigner status and gender (1999-2010)

Variable	Individual level					Firm level
	Male EU	Female EU	Male non-EU	Female non-EU	Total	Total
Wage/hour (constant euros)	16.3	14.3	14.2	13.4	15.6	15.3
St. deviation	(8.57)	(8.08)	(7.94)	(7.83)	(8.45)	(5.47)
Worker characteristics						
Education level 1 (ISCED 1-2)	35.7	26.7	50.7	35.8	34.5	34.0
Education level 2 (ISCED 3-4)	41.9	42.1	34.8	36.7	43.4	42.2
Education level 3 (ISCED 5-7)	22.4	31.2	14.4	27.5	24.2	23.8
Fixed-term contracts	2.5	4.0	5.5	8.2	3.1	3.1
High tenure (>5 years)	56.2	51.1	38.2	27.3	53.3	53.6
Workers < 40 years	52.4	58.9	63.0	69.8	55.0	54.7
Occupations						
Managers	4.3	2.4	2.1	1.8	3.7	3.8
Professionals	10.1	9.2	6.7	10.1	9.7	9.2
Technical ass. Professionals	8.0	7.7	4.8	6.1	7.7	7.4
Clerical occupations	11.1	38.2	6.3	25.5	17.7	18.1
Service occupations	4.1	10.1	5.9	13.4	5.9	6.0
Crafts	31.0	10.9	32.9	10.0	25.8	27.1
Machine operators	23.1	10.8	21.9	7.1	19.7	19.0
Elementary occupations	8.2	10.8	19.4	26.1	9.9	9.4
Firm characteristics						
Mining and quarrying	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing	48.7	40.9	44.1	24.7	46.1	46.0
Electricity, gas and water supply	0.0	0.00	0.0	0.0	0.0	0.0
Construction	15.2	3.1	15.6	1.9	12.0	13.2
Wholesale and retail trade	15.1	24.1	11.8	17.6	17.2	17.5
Hotels and restaurants	1.4	3.3	6.4	12.8	2.4	2.3
Transport, storage and communication	8.2	6.3	8.8	6.5	7.7	7.1
Financial intermediation	1.0	2.6	1.0	2.5	1.3	1.2
Real estate, renting and bus. services	9.9	19.4	12.1	33.7	12.8	11.8
Firm size	83.9	89.1	74.4	90.7	80.9	64.3
Added value/h (constant euros)	55.5	57.5	53.5	62.3	56.0	56.4
Firm-level collective bargaining	20.9	17.1	18.3	14.1	19.7	16.5
Region						
Flanders	62.1	62.2	49.0	45.3	61.0	61.2
Brussels	11.6	16.2	26.8	36.4	14.2	13.2
Wallonia	26.3	21.6	24.1	18.3	24.9	25.6
Number of observations	**373728**	**136546**	**35690**	**9999**	**555963**	**23712**
Share of sample (%)	67.2	24.6	6.4	1.8	100	100

Table 2: Firm-level wage-setting equation without gender-immigrant interaction

Log av. hourly wage	OLS (1)	OLS (2)	OLS (3)	OLS (4)	Fixed-effects (5)	GMM-IV (6)
Labor productivity	-	-	-	0.10*** (0.01)	0.01** (0.00)	-0.00 (0.00)
Share of non-EU workers[a]	-0.24***[i] (0.02)[j]	-0.02 (0.01)	-0.00 (0.01)	-0.01 (0.01)	-0.02* (0.01)	-0.07 (0.06)
Share of women	-	-0.19*** (0.01)	-0.20*** (0.01)	-0.17*** (0.01)	-0.09*** (0.03)	-0.13** (0.05)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual and job characteristics[b]	No	Yes	Yes	Yes	Yes	Yes
Sectors and regions[c]	No	No	Yes	Yes	Yes	Yes
Firm characteristics[d]	No	No	No	Yes	Yes	Yes
Observations	23712	23712	23712	23712	23712	8333
Adjusted R^2	0.06	0.63	0.65	0.70		0.30
Within R^2					0.36	
Between R^2					0.61	
Underidentification test[e]						0.00
Weak identification test[f]						68.4
Overidentification test[g]						0.37
Endogeneity test[h]						0.54

Data source: SES-SBS 1999-2010.

[a] Omitted reference: share of EU workers.

[b] Individual and job characteristics include share of workers younger than 40 years, share of 8 occupational groups (reference: service occupations); 3 educational levels (reference: ISCED 1-2); share of fixed-term contracts; share of workers with more than 5 years of tenure.

[c] Sector and regional controls include 9 sectors (reference: manufacturing) and 3 regions (reference: Flanders).

[d] Firm controls include the logarithm of firm size, logarithm of capital and a dummy for firm-level collective bargaining. All regressions include year dummies.

[e] Underidentifcation test reports p-value of Kleibergen-Paap rk LM statistic.

[f] Weak identification test reports Kleibergen-Paap rk Wald F statistic.

[g] Overidentification test reports p-value of Hansen J statistic.

[h] Endogeneity test shows probability that endogenous regressors can actually be treated as exogenous.

[i] ***,**,* significant at 1, 5 and 10% levels, respectively

[j] HAC standard errors in parentheses.

Table 3: Firm-level wage-setting equation with gender-immigrant interaction

Log av. hourly wage	OLS (1)	OLS (2)	OLS (3)	OLS (4)	Fixed-effects (5)	GMM-IV (6)
Labor productivity	-	-	-	0.10***	0.01**	-0.00
				(0.01)	(0.00)	(0.00)
Share of male non-EU[a]	-0.29***[i]	-0.04***	-0.03**	-0.03**	-0.03**	-0.04
	(0.02)[j]	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)
Share of female non-EU[a]	-0.12**	-0.14***	-0.08***	-0.08***	-0.06*	-0.10**
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)
Share of female EU[a]	-0.08***	-0.20***	-0.21***	-0.18***	-0.10***	-0.15***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.05)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual and job characteristics[b]	No	Yes	Yes	Yes	Yes	Yes
Sectors and regions[c]	No	No	Yes	Yes	Yes	Yes
Firm characteristics[d]	No	No	No	Yes	Yes	Yes
Observations	23712	23712	23712	23712	23712	8333
Adjusted R^2	0.07	0.63	0.65	0.70		0.30
Within R^2					0.37	
Between R^2					0.61	
Underidentification test[e]						0.00
Weak identification test[f]						116.1
Overidentification test[g]						0.53
Endogeneity test[h]						0.52

Data source: SES-SBS 1999-2010.

[a] Omitted reference: share of male EU workers.

[b] Individual and job characteristics include share of workers younger than 40 years, share of 8 occupational groups (reference: service occupations); 3 educational levels (reference: ISCED 1-2); share of fixed-term contracts; share of workers with more than 5 years of tenure.

[c] Sector and regional controls include 9 sectors (reference: manufacturing) and 3 regions (reference: Flanders).

[d] Firm controls include the logarithm of firm size, the logarithm of capital and a dummy for firm-level collective bargaining. All regressions include year dummies.

[e] Underidentifcation test reports p-value of Kleibergen-Paap rk LM statistic;

[f] Weak identifcation test reports Kleibergen-Paap rk Wald F statistic;

[g] Overidentification test reports p-value of Hansen J statistic.

[h] Endogeneity test shows probability that endogenous regressors can actually be treated as exogenous.

[i] ***,**,* significant at 1, 5 and 10% levels, respectively

[j] HAC standard errors in parentheses.

Table 4: Firm-level wage-setting equation according to level of collective bargaining

Log av. hourly wage	Without firm-level bargaining			With firm-level bargaining		
	OLS	Fixed-effects	GMM-IV	OLS	Fixed-effects	GMM-IV
	(1)	(2)	(3)	(4)	(5)	(6)
Labor productivity	0.09*** [i]	0.01**	-0.00	0.11***	0.01	-0.00
	(0.01) [j]	(0.00)	(0.00	(0.01)	(0.01)	(0.01)
Share of foreigners [a]	-0.01	-0.02*	-0.20**	0.01	-0.03	-0.06
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.08)
Share of women [a]	-0.17***	-0.09***	-0.13*	-0.21***	-0.10***	-0.34***
	(0.01)	(0.03)	(0.07)	(0.02)	(0.03)	(0.12)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual and job characteristics [b]	Yes	Yes	Yes	Yes	Yes	Yes
Sectors and regions [c]	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics [d]	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19803	19803	5612	3909	3909	1508
Adjusted R^2	0.69		0.29	0.71		0.31
Within R^2		0.35			0.41	
Between R^2		0.60			0.64	
Underidentification test [e]			0.00			0.00
Weak identification test [f]			24.1			24.5
Overidentification test [g]			0.48			0.52
Endogeneity test [h]			0.06			0.99

Data source: SES-SBS 1999-2010.

[a] Omitted reference: share of male EU workers.

[b] Individual and job characteristics include share of workers younger than 40 years, share of 8 occupational groups (reference: service occupations); 3 educational levels (reference: ISCED 1-2); share of fixed-term contracts; share of workers with more than 5 years of tenure.

[c] Sector and regional controls include 9 sectors (reference: manufacturing) and 3 regions (reference: Flanders).

[d] Firm controls include the logarithm of firm size and the logarithm of capital. All regressions include year dummies.

[e] Underidentifcation test reports p-value of Kleibergen-Paap rk LM statistic;

[f] Weak identification test reports Kleibergen-Paap rk Wald F statistic;

[g] Overidentification test reports p-value of Hansen J statistic.

[h] Endogeneity test shows probability that endogenous regressors can actually be treated as exogenous.

[i] ***,**,* significant at 1, 5 and 10% levels, respectively

[j] HAC standard errors in parentheses.

Table 5: Firm-level wage-setting equation according to firm size

Log av. hourly wage	Below median firm size			Above median firm size		
	OLS	Fixed-effects	GMM-IV	OLS	Fixed-effects	GMM-IV
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Labor productivity	0.10***	0.00	-0.00	0.10***	0.01*	-0.01
	(0.01)	(0.00)	(0.00	(0.01)	(0.00)	(0.00)
Share of foreigners[a]	-0.06***[i]	0.00	-0.20	0.02	-0.04**	-0.04
	(0.01)[j]	(0.02)	(0.18)	(0.02)	(0.01)	(0.06)
Share of women[a]	-0.17**	-0.11***	-0.25***	-0.18***	-0.13***	-0.17***
	(0.01)	(0.02)	(0.11)	(0.01)	(0.02)	(0.06)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual and job characteristics[b]	Yes	Yes	Yes	Yes	Yes	Yes
Sectors and regions[c]	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics[d]	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11927	11927	1961	11785	11785	5997
Adjusted R^2	0.66		0.21	0.71		0.31
Within R^2		0.33			0.41	
Between R^2		0.51			0.64	
Underidentification test[e]			0.00			0.00
Weak identification test[f]			22.9			103.6
Overidentification test[g]			0.22			0.01
Endogeneity test[h]			0.33			0.77

Data source: SES-SBS 1999-2010.

[a] Omitted reference: share of male EU workers.

[b] Individual and job characteristics include share of workers younger than 40 years, share of 8 occupational groups (reference: service occupations); 3 educational levels (reference: ISCED 1-2); share of fixed-term contracts; share of workers with more than 5 years of tenure.

[c] Sector and regional controls include 9 sectors (reference: manufacturing) and 3 regions (reference: Flanders).

[d] Firm controls include the logarithm of firm size, the logarithm of capital and a dummy for firm-level collective bargaining. All regressions include year dummies.

[e] Underidentifcation test reports p-value of Kleibergen-Paap rk LM statistic;

[f] Weak identification test reports Kleibergen-Paap rk Wald F statistic;

[g] Overidentification test reports p-value of Hansen J statistic.

[h] Endogeneity test shows probability that endogenous regressors can actually be treated as exogenous.

[i] ***,**,* significant at 1, 5 and 10% levels, respectively

[j] HAC standard errors in parentheses.

Annex 1: Firm-level productivity equation

Log av. hourly value added	OLS (1)	OLS (2)	OLS (3)	OLS (4)	Fixed-effects (5)	GMM-IV (6)
Share of non-EU workers[a]	-0.38***[i]	-0.12***	-0.12***	-0.08**	-0.02	-0.00
	(0.04)[j]	(0.04)	(0.04)	(0.04)	(0.04)	(0.15)
Share of women	-	-0.20***	-0.22***	-0.12***	0.02	-0.27**
		(0.03)	(0.03)	(0.02)	(0.04)	(0.11)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual and job characteristics[b]	No	Yes	Yes	Yes	Yes	Yes
Sectors and regions[c]	No	No	Yes	Yes	Yes	Yes
Firm characteristics[d]	No	No	No	Yes	Yes	Yes
Observations	23712	23712	23712	23712	23712	8333
Adjusted R^2	0.01	0.19	0.20	0.30		0.00
Within R^2					0.02	
Between R^2					0.11	
Underidentification test[e]						0.00
Weak identification test[f]						68.4
Overidentification test[g]						0.82
Endogeneity test[h]						0.98

Data source: SES-SBS 1999-2010.

[a] Omitted reference: share of EU workers.

[b] Individual and job characteristics include share of workers younger than 40 years, share of 8 occupational groups (reference: service occupations); 3 educational levels (reference: ISCED 1-2); share of fixed-term contracts; share of workers with more than 5 years of tenure.

[c] Sector and regional controls include 9 sectors (reference: manufacturing) and 3 regions (reference: Flanders).

[d] Firm controls include the logarithm of firm size, logarithm of capital and a dummy for firm-level collective bargaining. All regressions include year dummies.

[e] Underidentifcation test reports p-value of Kleibergen-Paap rk LM statistic.

[f] Weak identification test reports Kleibergen-Paap rk Wald F statistic.

[g] Overidentification test reports p-value of Hansen J statistic.

[h] Endogeneity test shows probability that endogenous regressors can actually be treated as exogenous.

[i] ***,**,* significant at 1, 5 and 10% levels, respectively

[j] HAC standard errors in parentheses.

8. Endnotes

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

[ii] The average is calculated excluding the firm j.

[iii] The SES is a stratified sample. The stratification criteria refer respectively to the region (NUTS-groups), the principal economic activity (NACE-groups) and the size of the firm. Sampling percentages of firms are respectively equal to 10, 50 and 100 percent when the number of workers is lower than 50, between 50 and 99, and above 100. Within a firm, sampling percentages of employees also depend on size. Sampling percentages of employees reach respectively 100, 50, 25, 14.3 and 10 percent when the number of workers is lower than 20, between 20 and 50, between 50 and 99, between 100 and 199, and between 200 and 299. Firms employing 300 workers or more have to report information for an absolute number of employees. To guarantee that firms report information on a representative sample of their workers, they are asked to follow a specific procedure. For more details see Demunter (2000).

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

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

[vi] In addition to all variables shown in Table 1, the Mincer equations and Oaxaca-Blinder decompositions discussed in this paragraph also include time dummies. Detailed results have been omitted for space reasons but can be requested from the authors.

[vii] Some of the firm-year observations without immigrants are from firms that employ immigrants in other years, which is why we kept all observations in the sample used for estimating Equations 1 and 2 (observations without immigrants are automatically dropped for Equation 3). This being said, the regression results for Equations 1 and 2 presented in the next section are robust to the exclusion of the 47% of firm-year observations with no immigrants (excluding firms without immigrant leads to slightly higher coefficients for all foreigner variables).

[viii] Although smaller in size, the downward effect of firm fixed effects on the productivity parameter is also found in Bartolucci's (2014) estimations based on hourly value added in German firms.