

# Do Immigrants Affect Firm-Specific Wages?\*

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**Abstract:** We propose and test a novel effect of immigration on wages. Existing studies have focused on the wage effects that result from changes in the aggregate labour supply in a competitive labour market. We argue that if labour markets are not fully competitive, immigrants may also affect wage formation at the most disaggregate level – the workplace. Using linked employer-employee data, we find that an increased use of low-skilled immigrant workers has a significantly negative effect on the wages of native workers at the workplace – also when controlling for potential endogeneity of the immigrant share using both fixed effects and IV.

**Keywords:** Immigration, imperfect labour market, natives, wage formation.

**JEL:** F22, J31, J61

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## **I. Introduction**

Many developed countries have experienced marked increases in immigration in recent decades. As a result, there has been a renewed interest in the economic consequences of immigration, and a number of papers analysing the effects on the wages of native workers have emerged. Although the papers differ in their choice of econometric approach, the underlying idea is the same: immigration increases the supply of certain types of labour, which in turn affects the marginal product of all types of labour and hence the wages of native workers. The size and direction of these effects depend both on the realised inflows of immigrants and the assumed or estimated substitution patterns between different types of labour. As a consequence, some studies find relatively large negative effects of recent immigrant inflows on the wages of native workers (Borjas, 2003, 2006; Aydemir and Borjas, 2007, and Borjas *et al.*, 1997), while other studies find much smaller effects (Card, 1990, 2001, 2005; and Ottaviano and Peri, 2005, 2011).

In this paper, we propose and test an additional effect of immigration on the wages of native workers. We argue that immigration may not only affect wage formation through a change in the supply of labour at the aggregate level. If labour markets are not fully competitive, an increased use of immigrants at the firm level may directly influence the wages of native workers employed in the firm. This results in distributional consequences of immigration that are not captured by the aggregate supply side approach used in the existing literature where the focus is on the effects of inflows of immigrants into different skill groups and/or regions. Hence, our focus is on consequences of immigration which are complementary to those studied in the literature.<sup>1</sup>

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<sup>1</sup> Relative to the existing literature, a recent study by Wagner (2009) presents a more disaggregated case as he estimates the impact of immigration on wages and native employment by considering the variation in immigration flows across Austrian industries and regions. His main result is that immigration has a very

There exists solid empirical evidence that wages are firm specific; see Blanchflower *et al.* (1996), Hildreth and Oswald (1997), Arai (2003), Manning (2003), Falch (2010) and Staiger *et al.* (2010) among others. Local use of immigrants may therefore affect wage formation at the firm level. Below, we discuss different channels through which this may happen.

The hypothesis that the employment of immigrants affects firm-specific wages is tested using linked employer-employee data for 1993-2004 from a developed country (Denmark) that has experienced a particularly pronounced increase in the employment of immigrants. As we have observations on all individuals in the Danish labour market, we are able to construct very detailed measures of the use of immigrants at the workplace level. Furthermore, as the data are register based, measurement problems are negligible.

In our analysis, we distinguish between immigrants with three different levels of education: low-skilled, medium-skilled and high-skilled. Our OLS estimates show a significant negative relationship between the share of especially low-skilled immigrants in total employment at the workplace and the wages of native workers. From the OLS estimates we can, however, not conclude that this represents a causal effect of the immigrants. An alternative explanation may be that certain types of workplaces both attract many immigrants and pay lower wages, or that certain native workers select into workplaces with a high share of immigrants.

While we use fixed effects for each combination of worker and workplace – so-called job-spell fixed effects – to take care of time-invariant factors affecting both the wages of native workers and the share of immigrants, temporary shocks to demand may still lead to

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different impact on service industries and manufacturing industries. In contrast, we consider the variation across individual firms.

reverse causality. A priori, we would expect a positive firm-specific demand shock to increase both the wages of native workers and the immigrant share, as immigrants – due to a higher unemployment rate – are more easily available in the job market; see also Borjas (2001). This in turn creates an upward bias in the OLS and fixed effects estimates of the effect of immigrants on wages.

To deal with this problem, we instrument the different shares of immigrants in total employment at the workplace using the shares of different immigrant groups (defined by both education and region of origin) 5 years prior to the first year of our sample. These shares are multiplied by the regional development in the employment of these groups, which can safely be assumed exogenous to the individual firm. The idea behind this instrument is that workplaces with a high initial share of immigrants are also more likely to receive the largest subsequent inflows of immigrants due to the presence of immigrant networks and because workplaces that have experience with using immigrants may have lower marginal costs of employing additional immigrants. With fixed effects at the job-spell level, this instrument is by construction valid as long as firm-specific temporary shocks to demand are not too long-lasting (more than five years).<sup>2</sup> Similar types of instruments have also been used by, *e.g.*, Card (2001), Ottaviano and Peri (2005) and Cortes (2006) to instrument the regional shares of immigrants.

Our fixed effects and IV estimations confirm that a higher share of low-skilled immigrants has a negative impact on the wages of native workers. The negative effects from the OLS and FE regressions of hiring medium-skilled immigrants cannot be confirmed, as the IV strategy does not work in this case. As expected, the IV estimates with respect to low-skilled immigrants are also considerably more negative than the OLS and FE estimates.

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<sup>2</sup> Note that firm-specific permanent shocks are not a problem here since they will be captured by the job-spell fixed effects.

The rest of the paper is structured as follows. Data are described in Section II. In Section III, we discuss how the employment of immigrants may affect firm-specific wages of native workers, and we outline our empirical strategy. Section IV contains the estimation results. Finally, Section V concludes.

## **II. Data**

From the Integrated Database of Labour Market Research (IDA), we hold information on all Danish residents in the period 1980-2004.<sup>3</sup> From IDA, we first extract information about individual characteristics of workers for the years 1993-2004. We restrict the sample to include only full-time native workers in the age interval 18-65 years from workplaces with at least 10 employees in the non-primary private sector. Second, this sample is merged with individual information on income from the Income Registers in Statistics Denmark for the same period. Third, as all individuals in IDA are linked to workplaces, the total population of full-time employees aged 18-65 from IDA is used to construct a number of workplace characteristics such as the share of immigrants in the employment at the workplace. These variables are subsequently merged on to the sample of workers.

The hourly wage rate is the dependent variable used in the analyses to follow. The wage rate is calculated as total labour income plus mandatory pension payments divided by the total number of hours worked in any given year. The measure for total labour income as such is highly reliable, as it comes from the tax authorities, but hours worked are in some cases measured less precisely. To make sure that our results are not influenced by noisy observations, we trim the data by eliminating wage rate observations that are deemed to have a low quality by Statistics Denmark (3.3 percent of the observations). In addition, we discard the observations in the upper and lower 0.5 percentiles of the wage distribution. With these

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<sup>3</sup> For more details on the IDA data, see, *e.g.*, Abowd and Kramarz (1999).

data restrictions, the estimation sample for 1993-2004 contains 10,851,786 observations from 1,710,797 workers and 66,178 workplaces.

A number of individual socioeconomic characteristics are used as control variables in the analyses. There is information about age, gender, marital status, the presence of children aged 0-6 years in the household, size of city of residence, labour market experience, tenure and education.<sup>4</sup> Specifically, we work with three levels of education: *Basic education* (low-skilled), *vocational education* (medium-skilled) and *higher education* (high-skilled). This classification of education levels relies on Danish educational codes. *Higher education* basically corresponds to the two highest categories (5 and 6) in the International Standard Classification of Education (ISCED), *i.e.*, tertiary education. *Vocational education* is defined as the final stage of secondary education encompassing programmes that prepare students for direct entry into the labour market. Thus, persons with just upper secondary school or equivalent are not included in this category but in the *basic education* category, which also contains persons with less education. Descriptive statistics for the individual characteristics are presented in Table 1.

*[Insert Table 1 around here]*

In addition to the variables listed in Table 1, we include individual information on industry of work (18 different industries) and region of residence (5 regions) in the analyses.

With respect to workplace characteristics, we use a variable for the size of the workplace measured as the number of employees along with a number of variables for the composition of the employees. Table 2 summarises the main workplace level variables averaged over workplaces in 2004.

*[Insert Table 2 around here]*

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<sup>4</sup> Information about workplace tenure only goes back to 1980.

Of particular importance is the definition of immigrants used in the paper. Immigrants are defined as individuals born outside Denmark with non-Danish parents, *i.e.*, parents without Danish citizenship or parents born outside Denmark. If no information is available on the parents, an individual born abroad is also considered an immigrant. As a consequence, in the group of native persons, we include all individuals born in Denmark, irrespective of the status of the parents, as well as individuals born abroad when at least one parent is Danish.

Table 2 shows that workplaces that employ immigrants are typically larger and have higher shares of both low-skilled and high-skilled workers. Another way to put this is that the workplaces without immigrants use workers with vocational education (medium-skilled workers) more intensively. There is also a slightly higher share of female workers at these workplaces, whereas the shares of older workers and union members are almost identical across the two types of workplaces.

With respect to the industry distribution (not shown), workplaces that employ immigrants do not differ markedly from workplaces without immigrants among their employees. Hence, among the 18 different industries considered, we only find a markedly higher concentration of workplaces employing immigrants within two industries: (a) in the iron and metallic industries, where 13% of the workplaces with immigrants belong vs. 6% of the workplaces without immigrants; and (b) in professional services (14% vs. 10%). On the other hand, workplaces without immigrants display a higher concentration within construction (15% vs. 9%) and within retail (17% vs. 10%).

In the analyses to follow, we distinguish between immigrants with basic education (low-skilled), vocational education (medium-skilled) and higher education (high-skilled). Immigrants whose educational backgrounds are not known are included in the first category. Furthermore, in the construction of our instruments we also distinguish between four groups of origin countries of immigrants: (1) the EU-15 countries plus Norway and Iceland; (2) the

EU-12 countries (the countries that joined the EU in 2004 and 2007); (3) all remaining developed countries; and (4) developing countries.<sup>5</sup> Note that the country of origin of an immigrant is based on the parents' countries of birth (or citizenships) whenever that information is available. That is, an individual born by Swedish parents in Canada is considered Swedish.

Denmark is an interesting case to study since it is one of the European countries that has experienced the strongest relative increase in the employment of immigrants. Figure 1 shows the development in the importance of the different educational groups of immigrants in total employment in the period 1993-2004. We observe that especially the share of low-skilled immigrants in total employment has increased dramatically in the period considered. Its share has roughly doubled from around 1% in 1993-94 to well above 2% ten years later. However, also the share of high-skilled immigrants has increased considerably.

*[Insert Figure 1 around here]*

Table 3 shows how immigrants were distributed across education, origin and age groups in 1987, 1993, 1999 and 2004. By comparing Table 3 with Table 1, we can see that immigrants are less likely than natives to have vocational education, but more likely to have higher education or only basic education. Furthermore, the share with higher education has risen over the period considered, while the share of immigrants with only basic education has fallen. The distribution across age groups is more similar to that of natives, and has been relatively stable in the period considered. With respect to countries of origin, the distribution did not change much between 1987 and 1993, where the dominating group were immigrants from EU-15 countries. However, in the last part of the period considered, there is a marked

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<sup>5</sup> The last group also includes immigrants with unknown origins, as these are unlikely to belong to the first three groups.

increase in the share from less developed countries, such that this group constituted the largest group by 2004.

*[Insert Table 3 around here]*

Information about the education of immigrants is used to construct variables that measure the workplace shares of the different groups of immigrants among the employees. Summary statistics of these workplace-level variables are included in Table 4 below. Note that each immigrant group is only present in around one fifth of the workplaces. Also note that between 1987 and 1993, the shares of workplaces with the different types of immigrants present stayed relatively constant, and so did the average shares (and standard deviations of these). After 1993, the average shares increased significantly, especially for the low-skilled and high-skilled immigrants, which is consistent with the development shown in Figure 1. Also the shares of workplaces employing the different types of immigrants increased.

*[Insert Table 4 around here]*

The increases in the average shares do not seem to display any strong pattern across different types of firms. Hence, the overall average annual increase in the low-skilled immigrant share is 0.0025, and this average is relatively stable across (three) size groups (between 0.0019 and 0.0026), and 15 out of the 18 industry groups have averages between 0.0013 and 0.0040, while only three industries have smaller but still positive average increases.

Table 5 compares the wages of natives and immigrants with similar levels of education. It is easily seen that immigrants – at least on average – earn less than natives with a similar level of education. This may, of course, reflect selection on other characteristics – an issue which may be particularly relevant among the formally high-skilled – but the findings are at least consistent with results in Husted *et al.* (2001), who show that both wages and employment probabilities are particularly low for refugee immigrants in Denmark,

especially in the first years after their entry. Another interesting observation from Table 5 is that (very) young and (very) old immigrants apparently earn more than comparable natives. Again, this may reflect selection. Finally, immigrants from less developed countries earn less than other immigrants on average, in part because of a lower average education level.

*[Insert Table 5 around here]*

### **III. Theory and Empirical Strategy**

If labour markets are perfectly competitive, workers with identical qualifications will get the same wage, irrespective of where they work. In that case, there should be no effects on the wages of native workers from hiring immigrants at the workplace. In contrast, if labour markets are imperfect and firms have monopsony power or earn rents because of imperfectly competitive goods markets, there may be room for firm-specific wages. This in turn leaves room for firm and workplace characteristics – including the use of immigrants – to play a role for individual wages.

In this section, we first briefly describe two theoretical channels through which the employment of immigrants may affect the wages of native workers at the firm level. We then present the empirical strategy used to test the hypothesis that native wages are affected by the employment of immigrants at the workplace.

#### *Theory*

The first channel relies on the existence of firm-specific upward-sloping labour supply curves, *i.e.*, monopsony power in the labour market by individual firms. Such monopsony power may arise as a consequence of labour market frictions (Manning, 2003). If workers find it costly to move to another firm, have particular preferences for their current workplace or if they are simply ignorant or uninformed about alternative job possibilities, firms can pay them a wage which differs from their alternative wage, and the labour supply to a given firm

will then depend positively on the wage offered by the firm. There is recent evidence to suggest that such firm-specific labour supply curves actually do exist; see, *e.g.*, Falch (2010) and Staiger *et al.* (2010).

If the firm gets the opportunity to hire (additional) immigrants – either exogenously or because the firm invests in recruitment activities – this corresponds to an increase in the labour supply in this firm-specific labour market, shifting the firm-specific supply curve to the right. If immigrants and natives are substitutes, the result is a decrease in the wages of native workers; at least if the supply elasticity does not change (too much) by this shift (Manning, 2003). Hence, this effect of immigration can be seen as a firm-level version of the “traditional” effect of immigration considered in the literature, namely the effect of an increase in the supply of immigrants within a skill group or a region on the wage rate for that group/region; see, *e.g.*, Card (2001) and Borjas (2003).<sup>6</sup>

The second channel instead relies on the existence of imperfect goods markets which give rise to rent sharing between firms and workers, *i.e.*, non-competitive wage determination, either through bargaining (by unions or insiders) or through wage norms. There exists considerable evidence of such rent sharing taking place in practice; see, *e.g.*, Blanchflower *et al.* (1996), Hildreth and Oswald (1997) and Arai (2003).

If native workers are considered as being the insiders in the firm, employment of immigrants with worse outside options may signal to these insiders that the firm has another (and cheaper) source of labour to draw from. This may in turn weaken the bargaining position of the insiders, *i.e.*, the native workers; see, *e.g.*, Lindbeck and Snower (1986) and Rodrik (1997). Alternatively, bargaining may take place through a trade union, which negotiates

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<sup>6</sup> If immigrants and natives are complements, native wages may increase when the number of immigrants increases as argued by Ottaviano and Peri (2005, 2011). In this case, the firm demand for native workers may increase with the employment of immigrants.

wages on behalf of all workers in the firm. In the case of such collective bargaining, the wage is likely to depend on the average outside option of all the employees; see, *e.g.*, McDonald and Solow (1981). If more immigrant workers imply that the average employee has worse (better) outside options, the wage level in the firm will decrease (increase). The notion that immigrants actually have worse outside options than native workers is at least supported by the lower average wages of immigrants shown in Table 5, and confirmed by a number of other empirical studies; see, *e.g.*, Card (2005).

Yet another possibility is that the employment of immigrants affects the wage norm in the firm. Immigrant workers with poor outside options are likely to accept relatively low wages. Therefore, employment of these immigrants may decrease the wage norm in the firm, which negatively affects the wages of other workers in the firm.<sup>7</sup>

In the appendix it is illustrated in more detail how both an efficiency-wage model with wage norms and a bargaining model may give rise to a simple and testable relationship between the immigrant share and the wages of native workers at the workplace.

To sum up, according to both the monopsony explanation and the rent-sharing explanation, an increase in the use of immigrants may affect the wages of natives in the firm. In both cases, we will expect the consequences to be most severe for the natives most similar to the immigrants. In other words, negative effects should be strongest within skill groups, *e.g.*, from low-skilled immigrants to low-skilled natives. Positive effects, on the other hand, would be most easily explained as a result of complementarities in a monopsony situation and would be most likely to appear across skill groups, *e.g.*, from low-skilled immigrants to high-skilled natives.

Although, the main purpose of this paper is not to try to discriminate between the different explanations above, one difference between the explanations will be explicitly

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<sup>7</sup> Again, wages may instead increase if immigrants have better outside options than natives.

examined. Under the first channel, the size of any effect should not be related (at least not positively) to the degree of unionisation among the workers. If anything, unionisation should counteract the monopsony power of the firms. On the other hand, unionisation would be expected to magnify the effect of immigrants under the second channel – especially if rent sharing takes place through union bargaining.

### *Estimation Strategy*

We assume that wages of native workers are determined as:

$$w_{ijt} = a_0 + a_1 S_{jt} + a_2 X_{ijt} + e_{ijt}, \quad (1)$$

where  $w_{ijt}$  is the (log) wage of individual  $i$  in workplace  $j$  in period  $t$ ,  $S_{jt}$  is the share of immigrants in the employment at workplace  $j$  at time  $t$ , and  $X_{ijt}$  is a vector of time-variant observable individual and workplace characteristics affecting the value of the human capital of individual  $i$  in workplace  $j$  at time  $t$ . In the appendix, an equation of this form is derived in both an efficiency-wage model with wage norms and a model with union bargaining. Furthermore, Borjas (2003) has already shown how a similar relationship between the immigrant share and wages may arise when the supply of immigrants in a skill group (in our case the firm-specific labour market) increases.

In the estimations to follow, we split the share of immigrants,  $S_{jt}$ , into three variables: the share of low-skilled, medium-skilled and high-skilled immigrants, respectively. In each case, we use the share in total employment at the workplace. In the literature, it is common to focus on the share of immigrants within worker  $i$ 's own skill group as the explanatory variable. However, as we wish to estimate and compare effects within and across skill groups, we use the shares in overall employment at the workplace. To simplify the exposition and because the group of low-skilled immigrants is the largest group, we focus in the rest of this section on the case where  $S_{jt}$  is the share of low-skilled immigrants in total employment at the workplace.

OLS estimation of (1) may be biased for several reasons. First, unobservable workplace characteristics may cause some workplaces to both pay different wages and attract more immigrants. This could be the case for, *e.g.*, foreign-owned firms, where it is empirically well established that they pay higher wages; see, *e.g.*, Lipsey (2004). Alternatively, workplaces with unattractive working conditions may be required to pay higher wages (as compensation) and may at the same time attract more immigrants if these are less picky than native workers. Second, unobservable individual characteristics may also be correlated with the immigrant share if certain native workers select into the workplaces that hire many (or few) immigrants.

In the estimations to follow, we control for such unobserved workplace and worker characteristics using fixed effects for each combination of worker and workplace (so-called job-spell fixed effects). This is a very flexible way of controlling for unobserved time-invariant worker and workplace characteristics and results in the following specification of our empirical model:

$$w_{ijt} = a_0 + a_1 S_{jt} + a_2 X_{ijt} + \theta_{ij} + \epsilon_{ijt}, \quad (2)$$

where  $\theta_{ij}$  is the job-spell fixed effect. With fixed effects for each worker-workplace combination, identification is based on changes in the immigrant share at a workplace over time within a job-spell. Here, the relatively long time horizon of our panel (12 years) is very useful.

Still, reverse causality may bias estimates of  $a_1$  even with fixed effects included as in (2). This could happen if immigrants are attracted to firms that (in some periods) pay higher wages due to unobserved demand shocks. The argument is that immigrants are more likely than native workers to be hired by firms experiencing a positive shock, as immigrants are more easily available in the job market and/or have lower mobility costs; see Borjas (1999,

2001) who argues that immigrants “grease the labour market”. This in turn creates an upward bias on the estimate of  $a_1$  in (2).

Another upward bias on the estimate of  $a_1$  may arise when using job-spell fixed effects if different native workers are affected differently by the presence of immigrants, and if those most severely affected leave the workplace. This "endogeneity" of native responses is related to the critique by Borjas (2003) of the spatial approach in the literature. Similarly, the presence of immigrants may affect starting wages of new employees more than wages of existing employees, *e.g.*, because starting wages are more flexible. If workers are indeed affected differently and the most badly affected are those who leave or start employment, our fixed effects estimates will be upward biased or apply to "stayers" only.

To address the reverse causality problem, we instrument the share of low-skilled immigrants in workplace  $j$  in period  $t$ ,  $S_{jt}$ . As instrument, we use the shares of low-skilled immigrants in workplace  $j$  in 1987 (five years prior to the first year of our sample) from the four different groups of origin countries. These are multiplied with the regional increases between 1987 and  $t$  in the employment of low-skilled immigrants from the four groups of origin countries, respectively:<sup>8</sup>

$$\sum_{g=1}^4 S_{jg,1987} \cdot \left( \frac{\bar{S}_{gt}}{\bar{S}_{g,1987}} \right), \quad (3)$$

where  $g$  indexes the origin groups, and  $\bar{S}_{gt}$  and  $\bar{S}_{g,1987}$  are the shares of low-skilled immigrants from origin group  $g$  in overall regional employment in year  $t$  and in 1987, respectively.<sup>9</sup> Thus, we are basically using the 1987 distribution of immigrants across

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<sup>8</sup> Similar instruments are created for the two other immigrant variables: the share of medium-skilled immigrants and the share of high-skilled immigrants.

<sup>9</sup> Workplaces that did not exist in 1987 are imputed a value of zero for  $S_{jg,1987}$ . However, this only applies to about 5% of the workplaces.

workplaces to allocate the subsequent increases in immigrant employment at the regional level.

The idea behind this instrument is that immigrants are likely to obtain employment in workplaces which already employ immigrants (with similar origins). First, because these workplaces have overcome the barriers associated with employing immigrants: they have changed their working language, have made special allowances for cultural and religious diversities, and perhaps an initial uncertainty/scepticism about the consequences of employing immigrants has been removed. Thus, workplaces that have experience with using immigrants are likely to have lower costs of employing additional immigrants, and are hence more likely to employ more immigrants when the supply increases. Second, because of network effects among the immigrants. Networks have previously been shown to be important for the location choices of immigrants as they facilitate assimilation and the job search process; see, *e.g.*, Munshi (2003), and Hellerstein *et al.* (2008) find that network effects within ethnicity/race/skill-groups are important in determining the workplace of an individual, in particular for minorities and less-skilled (especially Hispanics). Furthermore, they find that labour-market networks tend to be race based, which makes it reasonable to distinguish between regions of origin of the immigrants in the construction of the instrument.

A recent paper by Andersson *et al.* (2010) strongly supports the relevance of our instrument. They find that immigrants are much more likely to have immigrant co-workers and that this can be (partly) explained both by language barriers among immigrants and immigrant social networks.<sup>10</sup> The relevance of the instrument is further supported by the descriptive statistics in Tables 3 and 4. Here we can see that (1) the distributions of immigrants and immigrant shares did not change much between 1987 and 1993; and (2) the

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<sup>10</sup> Hellerstein and Neumark (2008) also find that a substantial part of the observed ethnic segregation in US workplaces can be attributed to differences in English-language proficiency.

average share of, *e.g.*, low-skilled immigrants in firm employment more than doubled between 1993 and 2005, while the share of workplaces with low-skilled immigrants “only” increased by around 50%. Hence, the 1987-distribution of immigrant shares may indeed be able to predict the subsequent allocation of additional immigrants across workplaces.

As the regional development in immigrant employment can safely be assumed exogenous at the workplace level, our instrument is valid (exogenous) as long as the unobserved factors determining the historical immigrant shares do not affect subsequent wages. As job-spell fixed effects are included in the IV regressions, this is only a problem if a pre-sample *temporary* shock to wages (prices) affects both the immigrant share in 1987 and wages in part of the sample period. That is, the shock should last more than five years. However, if the shock lasts for the entire sample period, it will be captured by the fixed effects. Note also that similar types of instruments have previously been used by, *e.g.*, Card (2001), Ottaviano and Peri (2005), and Cortes (2006) to instrument the regional shares of immigrants.

One potential problem is if immigrants – for some reason – tend to gather in declining regions or industries, *i.e.*, regions or industries that experience lower wage growth. This could create a (negative) correlation between the initial immigrant share and subsequent wage changes. To eliminate this possibility, we include fixed effects for each combination of year, region and industry, resulting in a total of 1080 additional fixed effects. These additional fixed effects control for any region- and/or industry-specific, time-varying effects. In this way, we eliminate most of the aggregate variation in the inflows of immigrants, which is the variation used in existing studies to identify the wage effects of immigration. This implies that the effects of immigration estimated below are largely complementary to those of the existing literature.

Including region  $\times$  industry  $\times$  year fixed effects in addition to job-spell fixed effects is not straightforward, as the two sets of fixed effects are non-nested. Fortunately, a procedure developed by Cornelissen (2008) can handle two-way fixed effects that are non-nested in a memory saving way. We implement this procedure in the following section.

#### **IV. Empirical Results**

In this section, we first present the results of estimating our baseline specification using OLS, fixed effects (FE) and instrumental variables (IV). Afterwards, we consider a number of additional specifications – also to get a first idea of which of the theoretical channels are most important.

##### *Baseline Specification*

The first three columns of Table 6 contain the results of estimating the basic model in (2) using OLS when  $S_{jt}$  is the share of low-skilled, medium-skilled and high-skilled immigrants, respectively, in total employment at the workplace. Column 4 includes all three immigrant shares, while columns 5-8 contain the similar estimations with the inclusion of job-spell fixed effects.

*[Insert Table 6 around here]*

Individual control variables included in the regressions are: dummy variables for six different age groups, three education levels, gender, being married, city size and children aged 0-6 years in the household, as well as continuous variables for experience, experience squared, tenure and tenure squared. A number of variables to control for workplace characteristics are also included: the number of employees, the share of employees in different educational groups, the share of employees above 40 years of age and the share of female employees. Finally, a total of 1080 region  $\times$  industry  $\times$  year fixed effects are included

to control for industry and region specific changes as explained above. In the regressions with job-spell fixed effects, the time-invariant variables, of course, drop out.

In column 1, we find a significantly negative effect of the low-skilled immigrant share on the wages of native workers. The point estimate of  $a_1$  is -0.13. The estimated effect of medium-skilled immigrants in column 2 is numerically smaller (-0.09) but still significant, whereas the estimated effect of high-skilled immigrants becomes insignificant, although still negative. When all three immigrant shares are included as in column 4, only the effect of low-skilled immigrants is found to be significant and of the same size as in column 1.

Columns 5-8 include job-spell fixed effects. In columns 1-4, standard errors were clustered by workplace-year to take account of temporary firm-specific shocks creating a correlation between the error terms of individuals employed in the same workplace.<sup>11</sup> Unfortunately, the memory-saving procedure developed by Cornelissen (2008) to handle two-way non-nested fixed effects as in columns 5-8 is especially costly in terms of computing time when clustered standard errors are computed, and the procedure would not converge in our case. However, as explained by Angrist and Pischke (2009), an alternative approach may be to calculate the so-called Moulton factor manually and use this to scale up the usual standard errors. Hence, in columns 5-8, we report the normal standard errors scaled by the Moulton factor.<sup>12</sup> Note that the Moulton factor is likely to “over-adjust” the standard errors in our case. Thus, for the OLS regression in column 1, where we can compute both clustered

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<sup>11</sup> Clustering standard errors at an even higher level, the workplace level, to allow for arbitrary correlation between the error terms of all observations from the same workplace would increase standard errors further by approximately a factor 2.4, but would not remove the significance of the estimates.

<sup>12</sup> Note that with job-spell fixed effects included in the regression the Moulton factor can only be calculated at the workplace-year level and not at the workplace level. This is because the Moulton factor assumes a specific structure of the error term, namely the presence of a common element in the error term for observations from the same cluster. Such a term is eliminated by the inclusion of fixed effects at the cluster – or a finer – level.

standard errors, normal standard errors and Moulton factors, the difference between the normal standard errors and the standard errors clustered at the workplace-year level is of a factor 3.3 while the Moulton factor at the workplace-year level is 6.4.<sup>13</sup>

With job-spell fixed effects included, the estimated effect of low-skilled immigrants in column 5 becomes numerically smaller (-0.04), but remains significantly negative. More specifically, an increase in the share of low-skilled immigrants of, *e.g.*, 1 percentage point is found to reduce earnings of native co-workers by approximately 0.04% when job-spell fixed effects are applied. Hence, an increase in the share of low-skilled immigrants at the workplace by, say, 10 percentage points is found to reduce the wage of native workers by 0.4% on average. Similarly, the effect of medium-skilled immigrants is also found to be significantly negative, this time with a coefficient estimate of -0.03. As in the OLS regressions, the negative effect of high-skilled immigrants is insignificant when correcting standard errors with the Moulton factor. Including all three immigrant shares as in column 8 does not change the picture dramatically.

As argued above, OLS and fixed effects estimates are likely to be biased upwards due to the presence of firm-specific temporary shocks that drive up wages and attract more immigrants. To address this problem, we apply the IV (2SLS) strategy described in the previous section.<sup>14</sup> The results are contained in Table 7.

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<sup>13</sup> Clustering at the workplace level in the OLS regression in (1) yields standard errors which are approximately 30% larger than when using the Moulton factor at the workplace-year level. Hence, a very conservative approach – corresponding to clustering at the workplace level – would be to add 30% to the computed Moulton factor in the fixed effects regressions.

<sup>14</sup> The IV estimation is implemented as a two-stage least squares (2SLS) since this may generate more efficient estimates. It should be noted that our potentially endogenous regressor,  $S_{jt}$ , takes on values in the interval [0,1], so in principle the first stage equation should be a non-linear limited dependent variable model. However, Angrist and Krueger (2001) and Angrist and Pischke (2009) both argue in favour of using the more robust 2SLS

*[Insert Table 7 around here]*

The first-stage results in column 1 show that the suggested instrument works well in the case of low-skilled immigrants. In this case, the estimate of the coefficient to the (demeaned) instrument is significantly positive indicating that a higher initial share of low-skilled immigrants is indeed associated with a higher subsequent intake. Furthermore, the first-stage F-statistic is 23.7 (after applying the Moulton correction), which is well above the critical value of 10 suggested by Staiger and Stock (1997) and Stock and Yogo (2002) to avoid problems with weak instruments that can seriously bias the IV estimates; see also Bound *et al.* (1995) and Stock *et al.* (2002). For the other two immigrant shares, however, the instrument does not work. Hence, we do not proceed with second-stage regressions in these cases. The fact that the instrument works best for low-skilled immigrants is not too surprising given that network effects are likely to be most important for this group; see also Munshi (2003). High-skilled immigrants are more likely to find jobs through other channels.

The second column in Table 7 contains the relevant parameter estimate from the second-stage regression corresponding to column 1. The result supports the OLS and FE estimates that low-skilled immigrants have a significantly negative effect on the wages of native workers.<sup>15</sup> As expected, the IV estimate is also considerably more negative than the OLS and the fixed effects estimates, although with a somewhat higher standard error as well. For this reason, we choose not to place too much emphasis on the precise value of the IV estimate, but instead interpret it as an indication that the effect is likely to be quantitatively more important than suggested by the fixed effect estimate from Table 6.

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as using a non-linear first stage does not produce consistent estimates except in the case where the non-linear model happens to be exactly right.

<sup>15</sup> Note that the parameter estimate remains significant at the 5% level even after adding 30% to the Moulton factor (see footnote 13) if clustering at the workplace level is preferred.

In sum, while we find negative wage effects of both low-skilled and medium-skilled immigrants in the OLS and FE regressions, only the former effect could be confirmed in the IV regressions. The fact that the effects are most pronounced with respect to the low-skilled immigrants is consistent with the second theoretical channel from the theory section. Under bargaining or wage-norms, relatively worse outside options for low-skilled immigrants than for high-skilled immigrants (compared to similar native workers) may explain why an effect is only found with respect to low-skilled immigrants. Furthermore, bargaining through unions is typically more important for low-skilled workers, whereas high-skilled workers are more likely to negotiate their own wage. Hence, finding stronger effects of employing low-skilled immigrants is most consistent with an effect that goes through union negotiation. We will return to this issue below.

#### *Additional Specifications*

This section contains a number of additional specification checks in relation to the general effect documented in the previous section.

*[Insert Table 8 around here]*

First, columns 1 and 2 of Table 8 focus on the effects of hiring low-skilled immigrants as only these were found to significantly affect native wages in the IV regressions and were also associated with the largest (and most significant) effects in the OLS and FE estimations. Columns 1 and 2 basically reproduce the FE estimation in column 5 of Table 6 and the IV estimation in Table 7, but we restrict our attention to observations where the share of low-skilled immigrants is strictly positive. This is done in order to analyse how much of the negative effect found in Tables 6 and 7 is driven by variation at the extensive margin, *i.e.*, workplaces going from a situation without low-skilled immigrants among their employees to strictly positive shares. As can be seen, the FE and the IV estimates do not change qualitatively relative to Tables 6 and 7, although they are now closer together. The standard

errors are, however, also somewhat higher. In sum, it seems fair to conclude that the effects are not driven by variation at the extensive margin.

Second, columns 3-8 split the sample into low-skilled, medium-skilled and high-skilled natives in order to distinguish between effects within skill groups and effects across skill groups. We focus on FE estimations. Only for the estimation in column 3 did the corresponding IV estimation work, but it produced an insignificant (although negative) coefficient.

First, in line with the results of Table 6, we only find significant effects from hiring low-skilled immigrants. Effects of hiring medium-skilled and high-skilled immigrants are in all cases insignificant (although mostly negative) both within skill groups and across skill groups.

Second, it now turns out that only low-skilled natives are significantly affected by the employment of low-skilled immigrants. There is no evidence of negative effects across skill groups, but also no evidence of the complementarities across skill groups that would support the monopsony explanation. Instead, the fact that the negative effect of employing low-skilled immigrants is most pronounced for low-skilled natives is consistent with both of the theoretical channels from the theory section. Hence, under the monopsony explanation, the low-skilled natives are most likely to compete with the low-skilled immigrants in the firm-specific labour market, thereby being most adversely affected by an increase in the supply of low-skilled immigrants. Similarly, in a bargaining set-up, bargaining is likely to occur separately for different skill groups within the firm in which case the lower outside options for low-skilled immigrants only (or mostly) affect natives with a similar level of education. Finally, it is reasonable to expect that wage norms are likely to depend mostly on the wages of co-workers with similar levels of education.

Thus, while the above results do not allow us to discriminate between the different possible explanations, there is one testable difference between the two explanations: the presence of unions should not be expected to matter under the first channel or, if it does, it should diminish the effects of immigrants.

To test this, we multiply the share of low-skilled immigrants with the variable measuring the share of employees at the workplace who are members of a union. Only under the second channel – and in particular the one relying on union bargaining – should we expect the coefficient to this interaction term to become significantly negative.

The results of a fixed effects regression are shown in column 9 of Table 8. As can be seen, the interaction term is highly significant indicating that the effect becomes more negative with higher degrees of unionisation, which indicates that the effect runs through union bargaining.<sup>16</sup> However, in the corresponding IV regression (not reported) both terms are insignificant with very high standard errors – possibly due to multicollinearity between the predicted endogenous variables in the second stage. Hence, the IV estimations are unable to confirm the fixed effects results. Still, the findings provide at least some evidence in favour of union bargaining as the channel through which immigrants affect firm-specific wages.<sup>17</sup>

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<sup>16</sup> Note that the estimated effect is positive for low levels of unionisation (less than 50%), which is somewhat surprising. However, very few persons are employed in such firms. The median union share is 0.83, and the 5% percentile is 0.42. As a consequence, the positive effect is largely an out of sample prediction, and could simply be driven by the linearity imposed and the fact that the effect becomes more negative with high levels of unionisation. Hence, we should be careful not to interpret this finding too strongly.

<sup>17</sup> Finally, we tried to run industry-specific regressions, thereby obtaining industry-specific estimates of the effects of hiring low-skilled immigrants. As both theoretical channels rely on the existence of firm-specific rents, we analysed whether there was any relationship between the size of these industry-specific estimates and available measures of average profits per employee in the different industries, but we were unable to find any relationship.

## **V. Conclusion**

In this paper, we have proposed and tested a novel effect of immigration on the wages of native workers. Using detailed employer-employee data from Denmark for the period 1993-2004, we have shown that an increase in the workplace share of low-skilled immigrants from less developed countries lowers wages for native co-workers.

We have argued that in a labour market that is not perfectly competitive, such an effect may arise as workers and firms share firm-specific rents. One way this could happen is if the individual firms face upward-sloping labour supply curves which are shifted to the right by the employment of immigrants. Another possibility is that immigrants affect the bargaining position of natives or the wage norm through their limited outside options.

Our estimates point to a sizeable negative effect on native wages from hiring low-skilled immigrants. The effect is present both in OLS, fixed effects and instrumental variables (IV) regressions, while the negative effects from the OLS and fixed effects regressions of hiring medium-skilled immigrants cannot be confirmed in IV regressions, as the instruments do not work here. The finding that the effect of hiring immigrants at the workplace level is most significant – and quantitatively more important – in the case of low-skilled immigrants is consistent with the theory suggesting that the effect runs through (union) bargaining. This conclusion is further strengthened by the finding that the effect becomes stronger with a higher degree of unionisation in a fixed-effects regression.

## Appendix

In this appendix, we illustrate how an efficiency-wage model and a wage-bargaining model, respectively, may give rise to the simple relationship between the immigrant share and the native wages at the workplace level, which we test in the empirical part of the paper.

### *An efficiency-wage model*

The efficiency-wage model builds on *the fair wage-effort hypothesis* present in, *e.g.*, Akerlof and Yellen (1990).<sup>18</sup> We assume that there are two types of workers in a firm: native workers and immigrants. The model develops in two stages. In stage 1, firms determine the level of employment and the share of immigrants in employment. In stage 2, wages are determined.

The decisions of the firms in stage 1 are based on all costs associated with employing workers. These costs consist of wage costs (determined in stage 2) and “other costs” associated with employing different types of workers. We assume that there are only such “other costs” when hiring immigrants. Specifically, “other costs” consist of a fixed cost of hiring immigrants, and a marginal cost, which increases with the share of immigrants hired. The fixed cost reflects that if a firm hires immigrants, it may be necessary to make changes in the organisation of the firm, *e.g.*, because the immigrants do not perfectly master the local language, or because special allowances for cultural or religious diversities must be made. The increasing marginal cost reflects that finding immigrants suitable for the firms’ needs in the market becomes increasingly difficult.

These costs imply that even if there are wage differences between native workers and immigrants, a firm may end up employing both types of workers. Moreover, the share of immigrants may vary between firms because the costs of employing immigrants vary between firms. Different fixed costs imply that some firms choose to employ immigrants,

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<sup>18</sup> A review of the empirical evidence for this model can be found in Howitt (2002).

while others choose not to employ immigrants. Furthermore, different marginal costs imply that the share of immigrants differs between the firms employing immigrants.

We do not solve explicitly for the equilibrium at stage 1. Instead, we turn to stage 2 of the model, where wages are determined. What happens in this stage is of main interest in the following analysis.

The effort of each individual depends on the wage relative to what this individual considers to be a fair wage. In particular, we assume that the effort of individual  $i$  is given as:

$$e_i = \begin{cases} \left(\frac{W_i - W_i^*}{W_i^*}\right)^\beta & \text{if } W_i > W_i^*, \\ \mathbf{0} & \text{otherwise} \end{cases} \quad (\text{A1})$$

where  $W_i$  is the wage of worker  $i$  in the firm, and  $W_i^*$  is the wage which worker  $i$  considers to be fair.  $\beta$  is the elasticity of the effort with respect to the difference between the actual wage and the fair wage ( $0 < \beta < 1$ ).<sup>19</sup> The effort function shows that a worker puts more effort into the job if the wage increases relative to what is considered to be the fair wage.

The firm is assumed to determine the wage rate by minimising the wage per effort unit of the worker,  $W_i/e_i$ . This implies that the wage is given as:

$$W_i = \frac{1}{1-\beta} W_i^* \quad (\text{A2})$$

Next, we assume that the fair wage,  $W_i^*$ , depends on the outside option of the worker,  $R_i$ , as well as the wage norm in the firm. In particular, we assume that  $W_i^*$  is given by a weighted average of the two:

$$W_i^* = \bar{W}^\alpha R_i^{1-\alpha}, \quad 0 < \alpha < 1, \quad (\text{A3})$$

where  $\bar{W}$  is the wage norm, which we assume is given as the geometric average of all wages in the firm.<sup>20</sup> We assume that outside options may differ across native and immigrant workers

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<sup>19</sup> This type of effort function has been used by, *e.g.*, Summers (1988) and Romer (2001).

<sup>20</sup> Strictly speaking, it should be the average wage of all workers in the firm except worker  $i$ , but if the number of workers is not too small, the two measures will be virtually identical. We proceed as if this is the case.

with  $R_I$  being the outside option for immigrants and  $R_N$  the outside option for native workers.

Hence, with two types of workers (natives and immigrants), the average wage becomes:

$$\bar{W} = (W_S)^S (W_N)^{1-S}, \quad (\text{A4})$$

where  $S$  is the immigrant share in the firm,  $W_I$  is the wage of immigrants (who are all assumed to be identical), and  $W_N$  is the wage of native workers (also assumed identical). In practice, where workers also differ in terms of observable human capital, we can think of the wages,  $W_I$  and  $W_N$ , as human-capital adjusted wages.

By using (A3) and (A4) in (A2), we find that:

$$w_N = \frac{c}{1-(1-S)\alpha} + \frac{S\alpha}{1-(1-S)\alpha} w_I + \frac{1-\alpha}{1-(1-S)\alpha} r_N \quad (\text{A5})$$

$$w_I = \frac{c}{1-S\alpha} + \frac{(1-S)\alpha}{1-S\alpha} w_N + \frac{1-\alpha}{1-S\alpha} r_I \quad (\text{A6})$$

where  $w_N = \log(W_N)$ ,  $w_I = \log(W_I)$ ,  $r_N = \log(R_N)$ ,  $r_I = \log(R_I)$ , and  $c = -\log(1 - \beta)$ .

These equations illustrate how the wage of one type of worker spills over to the wage of the other type of worker through the wage norm in the firm. By solving (A5) and (A6) with respect to  $w_N$  (and  $w_I$ ), we find that the wage of native workers in the firm is given by:

$$w_N = \frac{c}{1-\alpha} + r_N + \alpha(r_I - r_N)S \quad (\text{A7})$$

If the outside options of immigrants and natives are identical,  $r_I = r_N$ , it has no implications for the wages of native workers that the firm hires more immigrants. However, if the outside options of the immigrants are worse than the outside options of native workers,  $r_I < r_N$ , the wages of native workers in the firm decrease, as the share of immigrants goes up. Similarly, if the outside options of immigrants are better than those of native workers,  $r_I > r_N$ , the wages of native workers increase if the firm hires more immigrants.

### *A wage-bargaining model*

A wage-bargaining model may give rise to a wage equation similar to the one in (A7). To illustrate this, we assume that a representative firm faces the following demand curve:

$$P = \bar{P}Q^{-b}, \quad 0 < b < 1, \quad (\text{A8})$$

where  $P$  is the price,  $Q$  is production, and  $\bar{P}$  is the price in competing firms. The price elasticity of demand is  $-1/b$ . In a competitive market,  $b = 0$ , *i.e.*, the demand curve is horizontal at  $\bar{P}$ . Production is given by:

$$Q = L, \quad (\text{A9})$$

where  $L$  is employment. Hence, the profit of the firm is:

$$\Pi = PQ - WL, \quad (\text{A10})$$

The workers are assumed to be organised in a trade union with pay-off function:

$$U = L(W - \bar{R}), \quad (\text{A11})$$

where  $\bar{R}$  is the alternative income of trade union members if they do not receive a salary from the firm, *i.e.*, their average outside option. This pay-off function implies that the trade union seeks to maximise the total income of their members in the firm.

The wage (of all workers) is determined in negotiations between the firm and the trade union, and the outcome is assumed to be given by the Nash bargaining solution (see, *e.g.*, Binmore *et al.*, 1986):

$$W = \arg \max (U - \bar{U})^\beta (\Pi - \bar{\Pi})^{1-\beta}, \quad 0 < \beta < 1, \quad (\text{A12})$$

where  $\bar{U}$  is the pay-off to the trade union in case of a break-down in the negotiations. We assume that in this case, trade union members receive their outside option, implying that  $\bar{U} = 0$ .  $\bar{\Pi}$  is the pay-off to the firm in case of a break-down in the negotiations, and in order to get a closed-form solution, we assume that  $\bar{\Pi} = 0$ .  $\beta$  is the relative bargaining power of the trade union.

Solving this bargaining problem implies that the wage of worker  $i$  is:

$$W_i = \frac{1}{1-2\beta} \left( (1-\beta) + \frac{\beta}{b-1} \right) \bar{R}. \quad (\text{A13})$$

Bargaining implies that the wage in general is above  $\bar{R}$  unless the trade union does not have any bargaining power,  $\beta = 0$ , or if the goods market is competitive,  $b = 0$ , in which case

there are no rents to bargain about. We assume that the average outside option,  $\bar{R}$ , is given by the geometric average of the outside options of the workers employed. With two types of workers (natives and immigrants),  $\bar{R}$  is thus given by:

$$\bar{R} = (R_I)^S (R_N)^{1-S}, \quad (\text{A14})$$

where  $S$  is the immigrant share in the firm, and  $R_I$  and  $R_N$  are the outside options of immigrants and natives, respectively.

If we use (A14) in (A13) and take logs, the wage for native (and immigrant) workers becomes:

$$w_N = \log \left( (1 - \beta) + \frac{\beta}{b-1} \right) - \log(1 - 2\beta) + r_N + (r_I - r_N)S, \quad (\text{A15})$$

where  $w_N = \log(W_N)$ ,  $r_N = \log(R_N)$  and  $r_I = \log(R_I)$ . Note the similarity between (A7) and (A15). As for (A7) it follows that if the outside options of immigrants and natives differ, the wages of native workers will be affected when the firm hires more immigrants.<sup>21</sup>

In order to get a closed form solution, we assumed that  $\bar{\Pi} = 0$ . It can be shown that increasing  $\bar{\Pi}$ , *i.e.*, increasing the alternative pay-off to the firm in case of a break-down in the negotiations, implies that the wage decreases. Therefore, if hiring more immigrants also signals that the firm has better alternative options, there will be an additional effect on native wages through this channel.

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<sup>21</sup> As in the efficiency-wage model, different firms may choose to hire different numbers of foreign workers due to differences in hiring cost.

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**Table 1: Summary Statistics: Individual Characteristics**

	Mean	Std dev
Age 18-24	0.1055	
Age 25-29	0.1330	
Age 30-39	0.3019	
Age 40-49	0.2453	
Age 50-59	0.1879	
Age 60-65	0.0175	
Female	0.3226	
Married	0.5354	
Children 0-6 years	0.2234	
Experience	16.6287	9.6523
Tenure	4.6214	5.3378
Basic education (low-skilled)	0.3567	
Vocational education (medium-skilled)	0.4711	
Higher education (high-skilled)	0.1721	
Union member	0.7864	
Copenhagen	0.2109	
Large city	0.1361	
Small city	0.6530	
Number of observations	10,851,786	

Notes: Summary statistics are computed as simple averages across all observations in the data set. See text for definitions of variables.

**Table 2: Summary Statistics: Workplace Characteristics, 2004**

	Workplaces without immigrants		Workplaces with immigrants	
	Mean	Std dev	Mean	Std dev
Number of employees	20.3130	15.8460	65.1474	134.4384
Female share	0.3663	0.3034	0.3454	0.2530
Share with basic education (low-skilled)	0.3328	0.2239	0.3659	0.2016
Share with vocational education (medium-skilled)	0.5282	0.2389	0.4419	0.2051
Share with higher education (high-skilled)	0.1390	0.2046	0.1922	0.2171
Share aged 40-65 years	0.4305	0.2454	0.4356	0.2121
Share union member	0.7050	0.2304	0.7053	0.2117
Immigrant share	0.0000	0.0000	0.1163	0.1276
Number of workplaces in 2004	20,071		12,413	

Notes: Summary statistics are computed as simple averages across all workplaces in the data set in 2004. See text for definitions of variables.

**Table 3: Immigrant Characteristics, Selected Years**

	Means			
	1987	1993	1999	2004
Age 18-24	0.135	0.077	0.090	0.067
Age 25-29	0.135	0.133	0.138	0.122
Age 30-39	0.307	0.296	0.364	0.356
Age 40-49	0.292	0.308	0.240	0.281
Age 50-59	0.111	0.166	0.150	0.147
Age 60-65	0.016	0.014	0.012	0.018
Basic education (low-skilled)	0.535	0.456	0.444	0.492
Vocational education (medium-skilled)	0.296	0.338	0.322	0.288
Higher education (high-skilled)	0.169	0.206	0.234	0.220
Origin country:				
EU-15, Norway and Iceland	0.442	0.452	0.342	0.290
EU-12 countries	0.054	0.059	0.048	0.049
Remaining developed countries	0.139	0.144	0.190	0.190
Less developed countries	0.364	0.345	0.419	0.470

Notes: Summary statistics are computed as simple averages across all immigrants in the data set. See text for definitions of variables.

**Table 4: Distribution of Workplace Immigrant Shares, Selected Years**

	Share of workplaces with share = 0	Mean share	Std dev	P90
Low-skilled immigrants, 1987	0.838	0.014	0.055	0.036
Low-skilled immigrants, 1993	0.851	0.011	0.049	0.026
Low-skilled immigrants, 1999	0.806	0.018	0.067	0.053
Low-skilled immigrants, 2004	0.765	0.026	0.083	0.077
Medium-skilled immigrants, 1987	0.860	0.008	0.033	0.020
Medium-skilled immigrants, 1993	0.849	0.009	0.036	0.023
Medium-skilled immigrants, 1999	0.804	0.013	0.044	0.042
Medium-skilled immigrants, 2004	0.793	0.014	0.045	0.050
High-skilled immigrants, 1987	0.919	0.004	0.023	0.000
High-skilled immigrants, 1993	0.907	0.004	0.024	0.000
High-skilled immigrants, 1999	0.862	0.008	0.031	0.019
High-skilled immigrants, 2004	0.850	0.009	0.034	0.024

Note: See text for definitions of variables. P90 is the 90th percentile.

**Table 5: Hourly wages of Natives and Immigrants, 2004**

	Natives		Immigrants	
	Mean	Std dev	Mean	Std dev
All	197.4	80.7	181.2	73.1
Age 18-24	120.0	46.5	128.2	45.6
Age 25-29	170.3	48.8	161.9	50.3
Age 30-39	205.0	75.3	182.8	70.7
Age 40-49	213.7	87.6	187.4	75.4
Age 50-59	204.4	82.2	195.7	81.1
Age 60-65	210.6	86.5	216.2	87.3
Basic education (low-skilled)	170.0	69.5	166.2	65.6
Vocational education (medium-skilled)	189.8	63.3	177.6	61.4
Higher education (high-skilled)	255.4	99.9	217.3	88.3
Country of origin:				
EU-15, Norway and Iceland			210.4	89.7
EU-12 countries			180.0	74.2
Remaining developed countries			175.6	68.7
Less developed countries			166.2	56.6

Notes: Average hourly wages (in DKK) are computed as simple averages across all observations in the different categories. See text for definitions of variables/categories.

Table 6: Immigrants at the Workplace and the Wages of Native Workers, OLS and FE Results

	Dependent variable: log(hourly wage)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	FE	FE	FE	FE
Share in workplace employment of:								
Immigrants (low-skilled)	-0.1305*** (0.0096)			-0.1287*** (0.0095)	-0.0415*** (0.0125)			-0.0394*** (0.0125)
Immigrants (medium-skilled)		-0.0896*** (0.0147)		-0.0216 (0.0137)		-0.0335** (0.0168)		-0.0294* (0.0168)
Immigrants (high-skilled)			-0.0407 (0.025)	0.0271 (0.0253)			-0.0296 (0.0218)	-0.0249 (0.0219)
Job-spell fixed effects					yes	yes	yes	yes
Region * time * industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	10,851,786	10,851,786	10,851,786	10,851,786	10,851,786	10,851,786	10,851,786	10,851,786
R-squared	0.4213	0.4212	0.4212	0.4213	0.9303	0.9303	0.9303	0.9303
Moulton factor	6.410	6.414	6.415	6.410	4.182	4.182	4.182	4.182

Notes: Estimations are based on a panel from 1993-2004. The panel includes the full population of full-time private sector native workers aged 18-65 from workplaces with 10+ employees. Control variables included but not reported are: 1) Individual characteristics: experience, experience<sup>2</sup>, tenure, tenure<sup>2</sup>, individual dummy variables for age (six groups), education (three groups), marital status, children aged 0-6 years, and city size (three groups); 2) Workplace characteristics: Number of employees (log), share of women in employment, share aged 40+, share of employees with higher education, share with vocational education, and share with membership of a trade union. In the fixed effects estimations, some of these variables drop out. Standard errors are in parentheses. In columns (1)-(4), standard errors are clustered at the workplace-year level. In columns (5)-(8) standard errors are corrected with the Moulton factor at the workplace-year level calculated using the Stata intraclass correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

Table 7: Immigrants at the Workplace and the Wages of Native Workers, IV Results

	Dependent variable: log(hourly wage)	
	(1)	(2)
	First stage	Second stage
Instrument	0.0494*** (0.0101)	
Predicted workplace employment share of low-skilled immigrants		-1.4779*** (0.5270)
Job-spell fixed effects	yes	yes
Region * time * industry fixed effects	yes	yes
Observations	10,851,786	10,851,786
R-squared	0.8808	0.9303
Fist-stage F-test of instrument	23.70	

Notes: Estimations are based on a panel from 1993-2004. The panel includes the full population of full-time private sector native workers aged 18-65 from workplaces with 10+ employees. Control variables included but not reported, see table 6. See text for description of instrument used. Standard errors in parentheses are corrected with the Moulton factor at the workplace-year level calculated using the Stata intraclass correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

Table 8: Immigrants at the Workplace and the Wages of Native Workers, Additional Specifications

	Dependent variable: log(hourly wage)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Intensive margin		Low-skilled		Medium-skilled		High-skilled		Union interaction
	FE	FE-IV	FE	FE	FE	FE	FE	FE	FE
Share in workplace employment of:									
Immigrants (low-skilled)	-0.0649*** (0.0226)	-1.1796** (0.5791)	-0.0605*** (0.0207)	-0.0563*** (0.0208)		-0.0148 (0.0193)		0.0565 (0.0409)	0.0976** (0.0370)
Immigrants (medium-skilled)				-0.0399 (0.0299)	-0.0081 (0.0244)	-0.0072 (0.0245)		-0.0224 (0.0556)	
Immigrants (high-skilled)				-0.0691 (0.0421)		0.0015 (0.0360)	-0.0129 (0.0459)	-0.0145 (0.0460)	
Interaction with union share									-0.1937*** (0.0485)
Job-spell fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Region * time * industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5,242,610	5,242,610	3,871,063	3,871,063	5,112,660	5,112,660	1,868,063	1,868,063	10,851,786
R-squared	0.9354	0.9354	0.9388	0.9388	0.9006	0.9006	0.9276	0.9277	0.9303
First stage:									
Instrument, coefficient estimate		0.0669*** (0.0165)							
F-test of instrument		16.49							

Notes: Estimations are based on a panel from 1993-2004. The panel includes the full population of full-time private sector native workers aged 18-65 from workplaces with 10+ employees. Control variables included but not reported, see table 6. See text for description of instrument used. Standard errors in parentheses are corrected with the Moulton factor at the workplace-year level calculated using the Stata intraclass correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

Figure 1: Immigrants by Skill Level in Percent of Total Employment (18-65 years), 1993-2004

